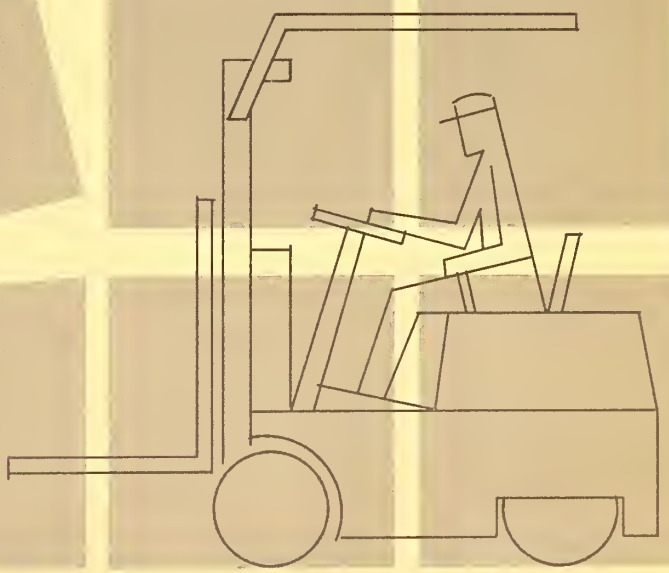
Marketing Research Report No. 652

BREAKAGE and DAMAGE

in grocery warehouses and retail food stores



TRANSPORTATION AND FACILITIES RESEARCH DIVISION / AGRICULTURAL MARKETING SERVICE / U.S. DEPARTMENT OF AGRICULTURE

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PREFACE

The Agricultural Marketing Service has received a number of requests to make a study of breakage and damage in grocery warehouses and retail food stores in order to get some idea of the extent of such losses, their causes, and possible ways of reducing them. In response to these requests, this case study was made in the facilities of three firms: P & C Food Markets, Inc., Syracuse, N. Y.; Red Owl Stores, Inc., and Super Valu Stores, Hopkins, Minnesota. Their cooperation and active participation were essential to its success. The data collected in this limited way should help other wholesalers and retailers confronted with breakage problems to reduce their costs.

Increases in marketing costs are normally reflected back to the farmer in lower returns, or to the consumer in higher prices, or both, as competition among traders generally adjusts costs and margins. Conversely, reduction of costs can benefit all interested groups--producers, processors, distributors, and consumers.

This study is part of a broad program of research by the Agricultural Marketing Service aimed at holding down the costs of marketing farm products by increasing the efficiency of food wholesaling and retailing.

The study was conducted under the general direction of R. W. Hoecker, chief, and John C. Bouma, marketing specialist, of the Wholesaling and Retailing Branch, Transportation and Facilities Research Division, Agricultural Marketing Service.

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BREAKAGE AND DAMAGE IN GROCERY WAREHOUSES AND RETAIL FOOD STORES

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SUMMARY

Grocery product losses caused by breakage and damage in warehousing, 1/ in delivery to retail stores, and in retail stores result in losses estimated at over $35 million annually. In this study, 73 percent of the total loss occurred at the retail store. The objective of this study was to identify the causes of damage in grocery warehouses and retail food stores and to suggest ways of reducing or eliminating such damage.

In the warehouses studied there were 66 causes of the damage that occurred, 12 of which accounted for 70 percent of the damage. Thirty percent was caused by reasons not found in all the warehouses (called "unique causes" in this report), such as the type of handling equipment used, uneven floors, or protruding plumbing and support columns. Six reasons caused over half of the damage in the warehouses studied; the damage rates are based on 100,000 cases shipped: Dropping cases in aisles, 16.1 cases; protruding nails in pallets, 15.8 cases; damaged by forks of lift trucks, 14.4 cases; damaged during storage, 14.4 cases; damaged in filling rack, 12.8 cases; and damaged during removal from the second-level slot in the rack, 8.6 cases.

Remedies for reducing warehouse damage include these examples: (1) Use of storage racks for bagged merchandise to eliminate the jamming of items into narrow slots caused by leaning stacks, and (2) avoidance of nail damage by covering the pallet face with light material such as a sheet of plywood, or purchasing pallets with high nail-retention ability.

Each warehouse used different methods for recovering part of the value of damaged merchandise. These procedures depended on such alternatives as allocation of damaged merchandise to retail stores, sales to salvage brokers, sales to employees, and recovery of cost of goods from manufacturers. Including the labor cost of recouping losses, two warehouses suffered losses of 30 and 49 percent of the wholesale value of the damaged cases.

1/ "Warehousing" in this study is confined to warehouses serving retail food stores; it does not include public or food processing warehouses.

Fifty-seven percent of the merchandise damaged in transit to the store was bagged or packed in glass. Transit damage accounted for about 2 percent of total damage losses.

In five supermarkets, 10 causes accounted for 62 percent of the damage and 37 reasons unique to individual supermarkets caused 38 percent of the damage. Of the 62 percent resulting from the 10 major causes, employees damaged 36.7 percent and customers 25.3 percent. The 10 causes were: Cartons damaged by the cutter blade during opening of case, 19.3 percent; items dropped by customer, 10.2 percent; items falling when disturbed by customers, 9.4 percent; items dropped during shelf stocking, 6.4 percent; merchandise stacks falling over in backrooms, 4.1 percent; merchandise crushed in stacks, 3.0 percent; items broken or crushed in shopping carts, 2.9 percent; items dropped by customers while unloading shopping carts, 2.8 percent; units falling out of open or torn shipping containers, 2.1 percent; and cases dropped while being taken from stock, 1.8 percent.

Typical of the recommendations for reducing store damage is the use of improved case cutters and cutting techniques, the pricing of some damageable items on the sales floor, and the use of storage racks in the storeroom for glass-packed and other easily damaged items.

The causes of damage and the corrective actions described herein should be of material help to warehouse and store operators in reducing the damage. The improved salvage room equipment and layout presented will reduce the cost and improve the effectiveness of recouping losses in warehouses.

INTRODUCTION

The breakage and damage of grocery products in warehousing, delivery, and store handling operations result in an estimated annual cost of over $35 million. 2/ Breakage and damage are reflected in lost sales, increased labor cost, and higher gross margin or lower net profit.

The objective of this research was to determine the causes and the extent of breakage and damage to dry groceries in warehouses and retail food stores. The report shows the causes of damage and offers suggestions for eliminating them. The suggestions are presented in general terms because the time and costs involved in changing equipment or practices and measuring the effect of each specific suggestion were beyond the resources available for the study. This report also measures the direct and indirect costs of damage occurring in grocery warehouses, in transit, and at the retail store.

2/ Based on 1962 food store sales in the United States, $56.2 billion (Progressive Grocer, April 1963, p.37); dry grocery sales of 45 percent, $25.3 billion ("Profile of Food Marketing," Ninth Biennial Grocery Study by This Week Magazine, p. 84); and a damage rate of 0.14 percent of dry grocery sales as found during these studies.

The findings are based on studies conducted in three warehouses, one of which was a corporate chain operation, one a voluntary group operation, and one a combination of the two. Two of the warehouses were located in the upper Midwest and one in upstate New York. Studies were also made in five retail food stores, each of which had different operating characteristics. The most important differences were the location of the grocery storeroom, methods used for receiving, case cutting, and price-marking, the place where price-marking was performed, and the methods used for shelf stocking.

Causes were not established for some of the minor types of store or warehouse damage. The causes given here represent the major causes of damage in only the firms studied. Since these firms used handling techniques in general use throughout the industry, similar causes of damage are likely to be found in other firms.

This study does not include merchandise damaged before receipt at the warehouse; it was observed during the studies that merchandise damaged in transit to the warehouse and received by motortruck was usually rejected at the time of delivery. Damaged merchandise received by rail was stored on the receiving dock, and a claim was entered with the insurance company. Important hidden costs of transit damage are dock congestion, handling, damage within the carton that is not apparent during receiving, and paperwork involved in filing claims.

In this report the terms "breakage" and "damage" have the same meaning and are both referred to as "damage." Warehouse damage is given in terms of damaged cases. A damaged case is one that contains one or more damaged or broken retail containers. Retail store damage is presented in terms of retail units, such as dented or crushed cans and broken glass-packed items.

GROCERY WAREHOUSES

The warehouses studied were chosen primarily because of their high volume, progressive management, and high employee morale. They had several differences.

Warehouse A used a short selection line, U-shaped bays, and floor slots for fast moving and bulky items. The aisle widths were 10 to 15 feet in the order selection area and 15 feet in the overhead towline aisle. Aisle width in the reserve storage area was 7 feet, and stacks were arranged at a 45^{o} angle to the aisle. Counterbalanced forklift trucks were used for putting merchandise into storage and removing it from storage. The two-way pallets were of wood and nail construction, measuring 40 inches on the face and 48 inches deep, and were nonreversible. Manually pushed selector trucks were used for order selection. When full, trucks were attached to the overhead perimeter towline, transported to the shipping dock, where they were removed and spotted at the truckloading points; merchandise was hand stacked in the truck trailer.

Warehouse B had a long selection line with a small area for reserve storage. Aisle widths were 10 feet in the order selection area. The main cross aisle, in which the in-floor perimeter towline was located, was about 20 feet wide. Counterbalanced forklift trucks were used for stock replenishment, and radio-controlled electric tractors, towing from one to three selector trucks, were used for order selection. When full, the selector trucks were attached one at a time to the towline and transported to the shipping dock. The cases were checked and hand stacked in the trailer. The pallets were of wood and nail construction and could be engaged by the forklift truck from any side.

Two sizes of pallets were used: One with 48-inch face and 40-inch depth for floor slots, and one with 32-inch face and 40-inch depth for the rack area.

Warehouse C was similar in many respects to warehouse B. Manually operated tractor-trains and an in-floor perimeter towline were used for order selection and transporting merchandise to the shipping dock. Cases were hand stacked in the truck trailer. A long selection line was used. Cross aisles were 7 feet wide and the center aisle was 20 feet wide. Winged type pallets of wood and nail construction, with 32-inch face and 40-inch depth, were used both in the rack area and in the floor slots. Straddle fork trucks were used for receiving and for slot replenishment.

In all three warehouses merchandise was received both by truck and rail, palletized during receiving, and transported to storage by forklift trucks. Two shifts were used, the day shift for receiving and the night shift for order selection and truckloading. In warehouse A a few orders were selected during the day; however, these orders were generally small.

Extent of Damage

In order to determine the amount of merchandise damage at the warehouse, records were maintained in warehouses A and B for 4 months and in warehouse C for 2 months. A comparison of the recorded damage with the warehouse movements indicated that damage ranged from 90 cases per 100,000 shipped in warehouse C to nearly 300 cases per 100,000 shipped in warehouse A.

The damage was divided into three major categories: (1) Damage from causes common to all three warehouses; (2) damage from causes unique to one warehouse or common to only two warehouses--generally due to differences in the facility or in equipment used; (3) concealed damage--merchandise damaged during shipment to the warehouse and not detected during receiving, or merchandise subsequently damaged in the warehouse and classified as concealed. Table 1 shows the extent of this damage in the three warehouses.

Table 1.--Cases damaged per 100,000 cases shipped, by major categories of damage, in three grocery warehouses

Warehouse	Damage due to common causes	Damage due to unique causes	Concealed damage	Total damage per 100,000 cases shipped
	Cases	Cases	Cases	Cases
A	209.3	76.1	14.2	299.6
B	60.1	32.4	7.4	99.9
C	57.7	27.6	4.7	90.0

Each damaged case contained one or more damaged retail containers. A sample of 200 damaged cases, containing 4,400 units, in one firm revealed that 1,452 units, or 33 percent of the retail containers, were partially damaged and 132 units, or 3 percent, were completely damaged, and 2,816 units, or 64 percent, were undamaged and salable.

Causes of Damage Common to Warehouses

Sixty-six causes were identified as being responsible for damage in the three warehouses. Not all the reasons, however, applied to any given warehouse. There were 43 causes of damage identified in warehouse A, 44 causes in warehouse B, and 30 causes in warehouse C. 3/

Twelve causes, common to the three warehouses, accounted for damage of 1,736 cases, or 70 percent of the damage by identified causes. The reasons ranged in their importance from 16.1 cases dropped in aisle, per 100,000 cases shipped, to 1.2 cases damaged during palletizing of poor shipping containers per 100,000 shipped (table 2).

The other reasons were unique to a given warehouse or common to only two and were responsible for the remaining 30 percent of the damage.

The common causes of warehouse damage seem to offer the most potential savings in damage reduction; however, their importance varied among the three firms. Some reasons were more significant in one or two of the warehouses; thus, each warehouse should be considered separately in determining priority for corrective action.

3/ See appendix tables 12 and 13 for a listing of reasons in each warehouse.

Table 2.--Merchandise damaged by causes common to three grocery warehouses

Causes of damage 1/	Total damage	Percentage of total damage	Damage per 100,000 cases shipped			
			Warehouse A	Warehouse B	Warehouse C	Average
	Cases	Percent	Cases	Cases	Cases	Cases
Common:						
Dropped in aisle	279	11.3	38.7	7.3	8.0	16.1
Nails in pallet	274	11.0	41.4	9.5	1.7	15.8
Damaged by tines on lift truck	251	10.1	26.6	5.0	16.6	14.4
Damaged during storage 2/	250	10.1	17.3	20.3	3.9	14.4
Damaged during filling of rack	223	9.0	34.9	.7	9.9	12.8
Damaged while being taken from second rack slot	150	6.0	23.9	3.6	2.0	8.6
Fell off selector truck 3/	78	3.1	2.7	5.2	5.1	4.5
Fell off pallet during receiving 4/	61	2.4	4.4	2.5	4.1	3.5
Stack fell over in trailer during loading 5/	59	2.4	4.9	2.3	3.6	3.4
Set down too hard on selector truck	54	2.2	7.2	1.8	1.3	3.1
Stack fell over, weak shipping container	37	1.5	6.5	.4	.6	2.1
Damaged during palletizing of poor shipping containers	20	.8	.8	1.5	.9	1.2
Total common damage	1,736	69.9	209.3	60.1	57.7	99.9
Unique	748	30.1	76.1	32.4	27.6	43.1
Total damage 6/	2,484	100.0	285.4	92.5	85.3	143.0

1/ See appendix table 12 for detailed causes of common damage.
2/ Includes: Bad letdown into narrow slot, fell while being maneuvered into storage, merchandise overhang, forklift backed into merchandise, bad swing by forklift into slot.
3/ Includes: Fell off selector truck while truck was being pushed into trailer, removed from towline, or positioned on the dock.
4/ Includes: Fell off pallet while traveling from the car to the dock, when pallet was engaged by forklift, and fell because of slick surface on case.
5/ Includes: Cases dropped in trailer during loading.
6/ Excludes concealed damage.

Cases damaged by being dropped in the aisle averaged 16.1 per 100,000 cases shipped in the three warehouses. This damage occurred principally during order selection, although merchandise may have been knocked from the pallet by the forklift truck while filling a slot behind the pallet on back-to-back selection racks. "Honeycombing" is partially responsible, since cases stacked this way may easily fall when nudged from behind (figure 1). "Honeycombing" results when order selectors take cases from pallets or racks haphazardly and leave other cases without proper support.

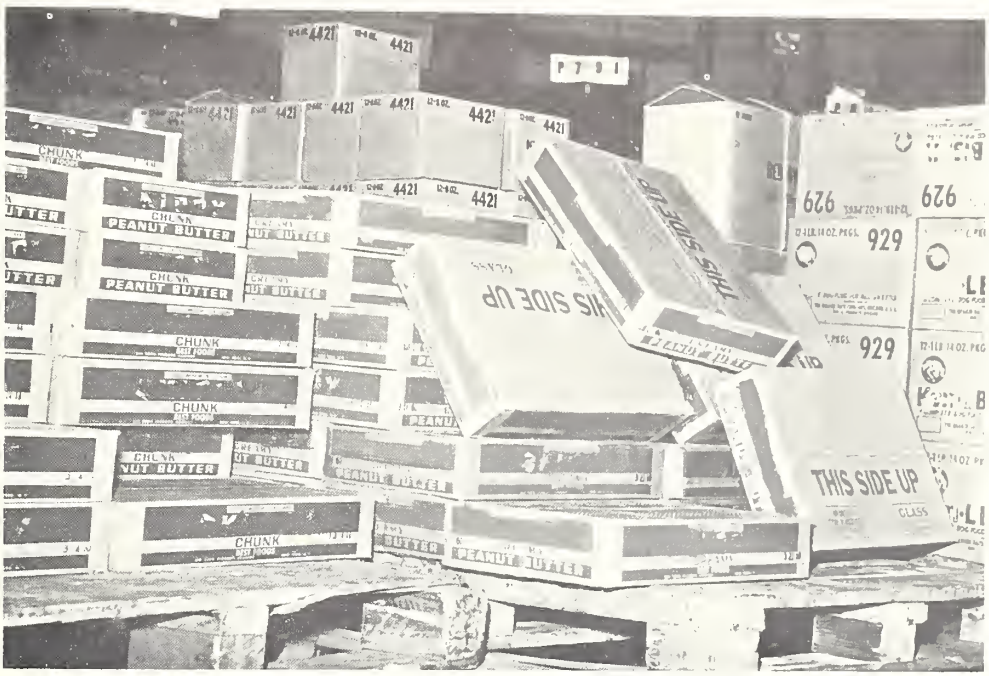

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Figure 1.--"Honeycombing" often contributed toward damage to merchandise dropped in aisle.

Damage caused by nails in the pallet was the second most important single cause of total damage in the three warehouses and was responsible for 11 percent of the damage. In warehouse A, nail damage was the most important cause of all damage, 41.4 cases per 100,000 shipped. In warehouse B, it was the second most important cause; however, in warehouse C it caused damage to only 1.7 cases per 100,000 shipped. The reason for this disparity was probably that warehouse C was only 2 years old, and its pallets were new, compared with 15-year-old and 10-year-old pallets in warehouses A and B. As pallets become older, nails work loose and protrude from the pallet. Bagged items are particularly susceptible to nail damage. Eighty-four percent of all damage to bagged items in warehouse A and 27 percent in warehouse B were attributed to this cause (table 3).

Table 3.--Nail damage compared with total damage of selected bagged items in two grocery warehouses

Bagged merchandise	Warehouse A			Warehouse B		
	Total bags damaged	Bags damaged by nails		Total bags damaged	Bags damaged by nails	
	No.	No.	Percent	No.	No.	Percent
Flour	102	96	94.1	133	33	24.8
Sugar	15	15	100.0	50	18	36.0
Salt	26	25	96.2	45	9	20.0
Dogfood	25	6	24.0	9	3	33.3
Total or average	168	142	84.5	237	63	26.6

Nail damage to the bagged items occurred in spite of cardboard placed on the surface of the pallets to protect the merchandise. If such measures are used, a stronger material such as plywood or composition board should be substituted. These one-piece sheets should have rounded corners. Protection should be provided on top of the merchandise, if placed in floor slots, because protruding nails of the pallet above will cause damage to the merchandise underneath it. It is not recommended, however, that bagged merchandise be stored in floor slots.

Some obvious solutions to nail damage are the purchase of pallets with improved nail-retention ability, nails covered with steel strapping, steel strapping instead of nails, joints glued rather than nailed, or pallets of plastic or metal construction. As previously indicated, the scope of this study did not include an evaluation of the performance of various types of pallets.

Tines on lift trucks damaged an average of 14.4 cases per 100,000 shipped. The damage was caused by the tines of the lift truck missing the pallet entry and striking the cases. This damage seems to occur more frequently during letdowns when the operator of the lift truck may misjudge the pallet entry and hit the palletized cases in overhead reserve storage. One solution for the racked items would be to mark lift truck masts so that the operator can readily see when the forks are at the proper height for safe engagement of the pallet. This solution would not apply to the floor slot area because of the variation in pallet heights. Eye examination, including depth perception testing, for lift truck operators may well be justified in view of the high incidence and cost of this type of damage.

Damage during storage accounted for an average of 14.4 cases damaged per 100,000 shipped. The following reasons are included in damage during storage.

- Merchandise overhang.--Because of the dimensions of the case, some items extend beyond the edge of the pallet. Certain items, such as some bagged dogfood, have a tendency to slide and therefore are hard to stack properly.

- Narrow slots.--Merchandise hanging over the edge of a pallet, or merchandise stacked three or four pallets high sometimes leans, narrowing the adjoining slot.

- Swing of forklift truck.--The driver's carelessness may cause damage to merchandise when he maneuvers the forklift truck to place merchandise in storage or to remove it from storage. However, the low incidence of 0.7 cases damaged in the three warehouses per 100,000 shipped indicates that this damage is negligible and may really be caused by merchandise overhang, leaning stacks, or poorly placed merchandise.

- Cases falling while being maneuvered into storage.--There are many reasons cases fall while they are being put into storage. Overhanging cases and improperly placed merchandise in adjoining slots contribute to this type of damage. The shifting of lightweight cases during transportation also causes damage. Since the top tier of shifted cases overhangs, the cases may collide with other merchandise and fall. Square-stacked cases (cases stacked directly above each other) are more likely to fall than cases in interlocking stacks.

- Forklift trucks backing into merchandise.--During the study it was observed that forklift trucks frequently backed into merchandise in floor slots opposite racked items. Additional damage was caused by floor slot items being placed in the aisle outside of the lane markings (figure 2).

These types of damage can be reduced:

1. By allowing proper clearance between pallets in the floor slot areas. Four inches between pallets and between pallets and columns is recommended, and steps should be taken to insure that it is maintained. 4/ This can be accomplished by installing yellow guidelines, either of tape or of paint, to indicate clearly where palletized merchandise should be placed. The warehouse foreman should exercise strict supervision to insure proper placement of the loaded pallets.

2. By stacking cases in square stacks on the pallet if the dimensions of the cases prevent interlocking to form a pallet block without excessive overhang. If these cases have a tendency to slide, the top tier on the pallet may be taped. Reusable strapping can also be used to secure the top tier.

4/ Bouma, John C., and Lundquist, Arnold L. Grocery Warehouse Layout and Equipment for Maximum Productivity. U. S. Dept. Agr. Mktg. Res. Rpt. 348, 48 pp., illus. July 1959.

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Figure 2.--Damage caused by lift trucks backing into merchandise.

3. By storing bagged items in drive-in racks with a minimum of 3 inches of clearance between pallets and uprights. Bagged items seem to hang over the edge of the pallets more than other merchandise, are subject to leaning, and are highly susceptible to damage when placed in floor slots.

4. By providing a temporary reserve storage location, as shown in figure 3, to eliminate the placing of merchandise in aisles outside of lane markings.

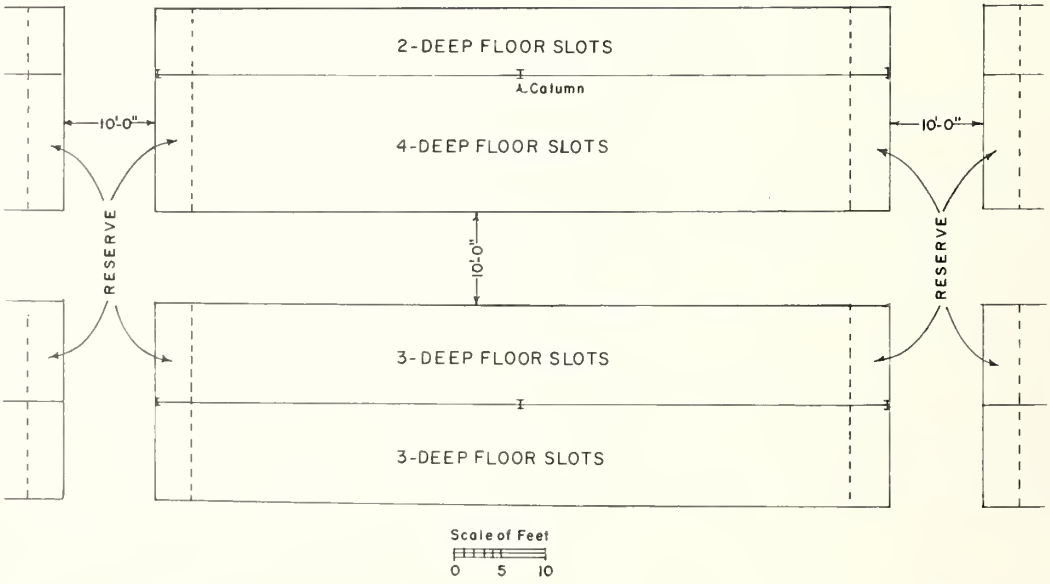

Figure 3.--Recommended temporary reserve storage in floor-slot areas to avoid aisle congestion and reduce damage.

Damage occurring during filling of racks accounted for an average of 12.8 cases damaged per 100,000 shipped. It occurred most often in warehouse A and amounted to 34.9 cases per 100,000 shipped. In warehouse B, only 0.7 case was damaged, and in warehouse C 9.9 cases were damaged per 100,000 shipped.

Warehouse B had pallet racks designed for three 32-inch-face pallets between uprights, which were spaced 102 inches apart. There were 2 inches of clearance between pallets and uprights and 1 inch between pallets. Some drive-in racks with 2 inches between pallets and uprights were also used. Observations of the drive-in rack area revealed some damage, particularly on bagged dogfood that was overhanging the pallet.

Although more space was provided in the rack area in warehouse A than in B, warehouse B had a lower incidence of this type of damage. It appears, therefore, that the difference in the amount of damage was due to the skill of the forklift truck driver in warehouse B, since the lift equipment in the two warehouses was similar.

The suggestion given in item 3, page 12, for reducing damage to bagged merchandise during storage is also recommended for reducing damage during filling of racks. If the bagged items are stored in double rack slots, 6 inches should be allowed between pallets and 3 inches between pallets and uprights.

In warehouse C the use of straddle lift trucks in the narrow (7-foot) aisle contributed to the damage of 9.9 cases per 100,000 shipped. Since this type of equipment straddles the pallet in the floor-level rack, the position of the floor-level pallet controls the placement of loaded pallets in the second-level slot and also in overhead storage. Yellow tape or painted guidelines, forming a rectangular pattern of pallet size, installed in floor-level slots would assist the lift operator in proper placement of the floor-level pallet. Figure 4 shows an example of "rack damage."

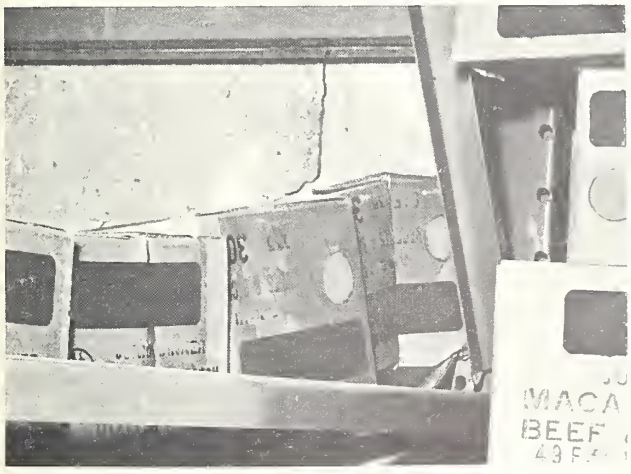

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Figure 4.--An example of merchandise damaged during filling of rack. Cases to the left of the rear upright have been jammed against the upright.

Cases damaged during removal from second rack slot averaged 8.6 cases per 100,000 shipped. The second rack slot, including the pallet, is a minimum of 56 inches from floor level. In many instances, cases in the second-level slot are very difficult to remove, and the selector sometimes climbs partially into the slot to obtain cases. One alternative to climbing is to "nudge" the top case, causing it to fall to pallet level, where it is easily obtainable. This practice frequently causes damage. A partial solution would be the provision of a small step on the upright to facilitate reaching into the slot.

Another partial remedy, which should be particularly effective in a fixed-slot warehouse, would require all glass-packed merchandise to be assigned floor-level slots. 5/

Cases falling from selector truck while truck was being pushed into the trailer, positioned at the dock, or removed from the towline averaged 4.5 cases per 100,000 shipped. Poorly stacked merchandise on the selector truck, such as large cases on top of smaller cases, and also overloaded selector trucks contributed to this type of damage. Order selectors should be properly supervised to hold this damage to a minimum. Rather than overload a selector truck, additional trucks should be used to complete the order. It is also recommended that a board or other material about 1 inch thick be placed on the outside edge of the selector truck platform. These strips cause the merchandise to tilt inward and keep the merchandise from falling from the truck, particularly if the truck is towed around sharp corners. 6/

Cases falling from the pallet during receiving averaged 3.5 cases per 100,000 shipped. The cases fell off while the pallet was traveling from the rail car or truck trailer to the dock or when the pallet was engaged by the forklift. The slick surface of the cases caused some cases to fall.

Measures taken to insure safe dock plates and proper operation of unloading equipment will reduce this type of damage. Dock plates should be long enough to provide a moderate pitch to the receiving dock and light enough to be easily installed. The rail dock should be about 45 inches above the top of the rail and should have 102 inches between the centerline of the track and the edge of the dock. 7/ Care exercised by forklift operators should reduce damage attributed to cases falling while fork is engaging the pallet. In some instances, taping the top tier of square-stacked cases may be required and would be particularly helpful on cases with slick surfaces.

Cases dropped and stacks falling over in the trailer during loading damaged 3.4 cases per 100,000 shipped. This damage seems to be due to worker carelessness, although one contributing factor is that some fragile retail containers are packed in poorly padded shipping cartons. Furthermore, in the warehouses studied it was a common practice to assign inexperienced employees to truckloading. These men should be taught the fundamentals of good truckloading procedures, including how to avoid damage. Careful handling of fragile merchandise will reduce truckloading damage, and proper stacking of merchandise within the trailer will reduce subsequent damage in transit to the store.

5/ For further information on fixed-slot grocery warehousing, see "Grocery Warehouse Layout and Equipment for Maximum Productivity," referred to in footnote 4, page 11.

6/ Bouma, John C. Methods of Increasing Productivity in Modern Grocery Warehouses U.S. Dept. Agr., Mktg. Res. Rpt. No. 94, 30 pp., illus., June 1955. (See pp. 10-11).

7/ See pages 9 and 27 of "Grocery Warehouse Layout and Equipment for Maximum Productivity," referred to in footnote 4, page 11.

Setting cases down too hard on the selector truck caused damage to 3.1 cases per 100,000 shipped and damaged items packed in glass more than any other type of retail container. This cause was responsible for 15 percent of all bottled items damaged and for 13 percent of the damage to jar-packed merchandise in warehouse A. Carelessness of the order selectors may be responsible. However, certain items were observed to be easily damaged by impact, and complaints to manufacturers may result in corrective action. Strengthening of the container or placing of additional cushioning materials in shipping containers are two possible solutions, especially since merchandise damage from such minor impact may indicate that additional damage can be expected in subsequent operations.

Merchandise damaged by stacks falling over because of weak shipping containers amounted to 2.1 cases per 100,000 shipped. One cause of this shipping container failure appeared to be moisture. The containers, when damp, lost their rigidity and did not support the weight of the pallets stacked above. Warehouse foremen indicated that breakfast cereals are prone to this type of damage, particularly during cold periods when the heat is turned off over a long weekend. Warm air, when cooled, releases moisture in the form of condensation. Manufacturers could apply a waterproofing material to shipping containers to reduce this damage. Further benefits to the merchandise, such as a fresh and uncrushed appearance when displayed at the store, may also result from waterproofing the containers.

Square-stacking cases on the pallet may also reduce this type of damage. Many shipping containers will provide more support and distribute weight more evenly when each case is placed directly over the one below. Square-stacked lightweight cases may require taping of the top tier to provide stability for the pallet load.

Cases damaged during palletizing because of poor shipping containers accounted for 1.2 cases (or bags) damaged per 100,000 shipped. This damage occurred most often to bagged merchandise. One of the items affected was bagged oyster shell, which obviously required stronger packaging.

Causes of Damage Unique to Individual Warehouses

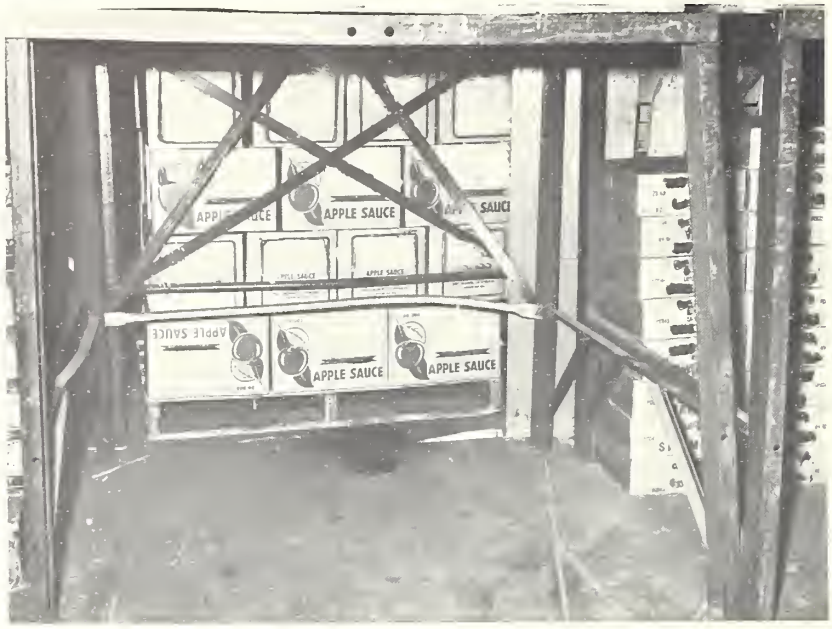
The unique causes of damage in the three warehouses were responsible for damage to an average of 43.1 cases per 100,000 shipped, or 30.1 percent of the identified damage (table 2). 8/ Some of the suggestions for reducing warehouse damage from "common" causes previously presented will also apply to some of the "unique" causes. Furthermore, only the most significant unique causes will be discussed.

Hitting the bar in the back of the racks caused damage in warehouse A to 24.5 cases per 100,000 cases shipped, and hitting the rack while being put into storage caused damage to 7.8 cases. 9/ A horizontal bar was placed at the

8/ The damage rates are based on all damage in a given warehouse, exclusive of concealed damage.

9/ A complete list of the causes of unique damage and the number of cases damaged are shown in table 13.

bottom of an X brace at the rear of the rack. Frequently, when a pallet was being placed in the rack, it passed under this bar, and the merchandise hit the bar (figure 5). The overhead towline installed in the rack area also made the filling of racks difficult and contributed to rack-filling damage.



BN-21418

Figure 5.--Bar in back of rack is bent from collisions with palletized merchandise.

Pallet wings were responsible for 13 cases damaged per 100,000 shipped in warehouse C and, thus, were a major cause of damage. Bagged merchandise was particularly susceptible. Warehousemen attributed 100 percent of the damage to bagged sugar, 25 percent of the damage to bagged dogfood, and 51 percent of the damage to bagged flour to pallet wings. The obvious recommendation of eliminating the winged pallet does not seem to be justified, however, since winged pallets reduce the space required between pallets in the rack and floor-slot areas, when straddle forklift equipment is used. Furthermore, damage attributed to pallet wings may, in fact, be due to other causes, such as narrow floor slots, improper placement of floor-level pallets, leaning merchandise in adjacent slots, and merchandise overhang. Since this damage significantly affected the bagged merchandise, the recommendation is again made to store these items in drive-in racks.

Hitting merchandise on pallet below during letdown damaged 7.8 cases per 100,000 shipped in warehouse B and 3.6 cases in warehouse A. When the forklift driver does not back away from the stock a sufficient distance to clear the merchandise already stored, the lowered pallet may strike the merchandise on the pallet below; often the faces are sheared from several shipping containers

(figure 6). This problem may be reduced by the installation of a sounding device to inform the driver that he has backed sufficiently and can safely lower the pallet. Such a device may be coupled to the lift truck wheel and may sound when sufficient revolutions of the wheel have been made.

BN-21419

Figure 6.--Damage caused in lowering pallet load of merchandise too close to stored merchandise.

Fell off selector truck while truck was being hooked onto towline damaged 5.5 cases per 100,000 shipped in warehouse A. This warehouse used an overhead towline to move the 4-wheel selector truck which was fastened to the towline by a steel bar. One end of the bar was attached to the selector truck by a chain; a hook on the other end was placed in the eye of the overhead towline. The truck lurched when it was attached to the towline, causing poorly stacked cases to fall.

Remedies that may apply are:

1. To exercise more care in loading handtrucks.

2. To replace the chain or the attaching device with a material that will absorb the initial impact of starting.

3. To have the order selector start moving the poorly loaded trucks after engaging the towline so that the slack in the chain may be taken up gradually.

Being rammed by handtrucks on the towline damaged 5.1 cases per 100,000 shipped in warehouse A. This damage was caused by order selectors leaving the selector trucks, on which they were assembling orders, in the path of trucks on the towline. Selector trucks moving on the towline sometimes collided with these parked trucks. The slack in the chains often contributed to this damage, by causing the selector trucks to move erratically, especially around corners. Merchandise in floor slots was often placed close to the overhead towline, and selector trucks could not be safely positioned on that side of the aisle without running the risk of colliding with towline handtrucks. The provision of temporary reserve storage slots in this area would reduce damage caused by handtrucks on the towline and forklift trucks colliding with handtrucks left in the aisles.

Damage due to leaning stack amounted to 4.8 cases per 100,000 shipped in warehouse C. The leaning stacks narrowed adjacent slots and caused damage during letdowns or filling of slots. More care exercised by forklift operators to center loaded pallets directly over pallet loads in floor slots should reduce this damage. Attention should also be given to placement of the floor-level pallet within the pallet guidelines. Merchandise prone to leaning should be placed in racks.

Cases crushed from stacking heavy merchandise too high caused damage to 5.0 cases per 100,000 shipped in warehouse C. Some merchandise placed in floor slots was packed in shipping containers not strong enough to support the weight of three additional pallet loads. The shipping container is not to be blamed entirely, since container failure may be partially due to the retail packages contributing little to internal support. In this warehouse about half of this damage occurred to merchandise, such as hot cereals, cake flour and mixes, granulated soap powders, and dry detergents, packed in retail containers made of paperboard. Isolation of items subject to this damage and storage in racks is recommended. Stacking the cases with the corners of one directly above the corners of the case below may also reduce this damage. The corners, or strongest part of the case, thus support most of the weight of cases placed above. With conventional stacking, cases are stacked in an interlocking pattern and the weight is supported by the middle or weak part of the case below, sometimes denting the case and damaging the packages in the case.

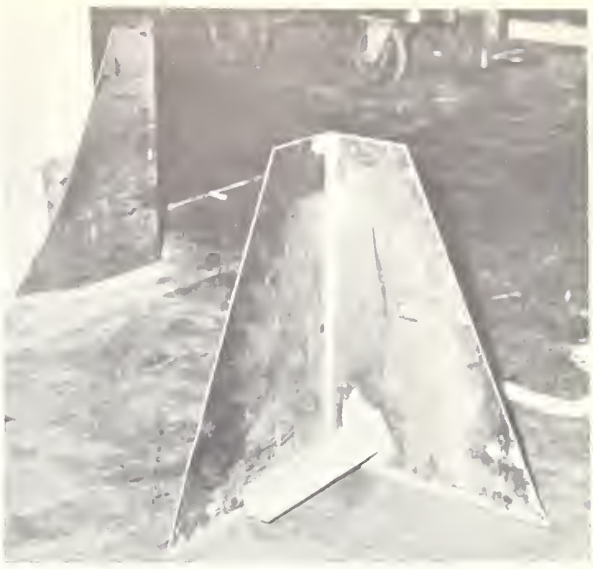
Cases on corners rammed by tractor or truck accounted for damage to 4.6 cases per 100,000 shipped. Records during the study indicated that about 150 cases were damaged annually on corners in warehouse A. The average loss sustained on damaged goods and the labor for recouping the 150 cases resulted in a loss of $226 a year. Some firms place metal guards on pallet corners at the ends of traffic aisles (figure 7). The costs of providing these metal guards should be weighed against the annual loss from this cause. It should be noted that warehouse A used manually pushed selector trucks. Warehouses using tow-tractor trains probably would have more corner damage. This was not the case in warehouse B, which had damage of only 0.4 case. However, warehouse B used corner guards to protect corners. Another possibility for reducing corner damage in warehouses using radio-controlled guidance for tractor-train order assembly is the use of "wire guidance." A wire is installed in the floor of the aisle, and the tractor-train automatically follows the wire after receiving a radio signal from the order selector. Proper placement of this wire insures that the train will turn the corners safely, thus avoiding corner damage.

The recommendations presented in this report should be helpful in reducing much of the warehouse damage; however, some commodities may require corrective action by manufacturers. While in the short run manufacturers may compensate wholesalers and retailers for damage, a long run and possibly less costly solution may be container redesign. Modern packaging and shipping container designers should consider all handling of the product in the distributive channels. Shipping containers should be designed with sufficient strength for and lend themselves to palletization on standard-size pallets. Disregard of this important factor wasted warehouse space and encouraged damage (figure 8). In warehouse B one item that definitely required a better container was bagged oyster shell. Figures 9 and 10 illustrate some typical causes of warehouse damage.

Classes of Commodities Affected by Warehouse Damage

To obtain an indication of the warehouse damage by commodities, records were maintained during two periods of 2 months each in warehouse B. Damage by product categories was compared with warehouse movement for the two periods.

A. BN-21421



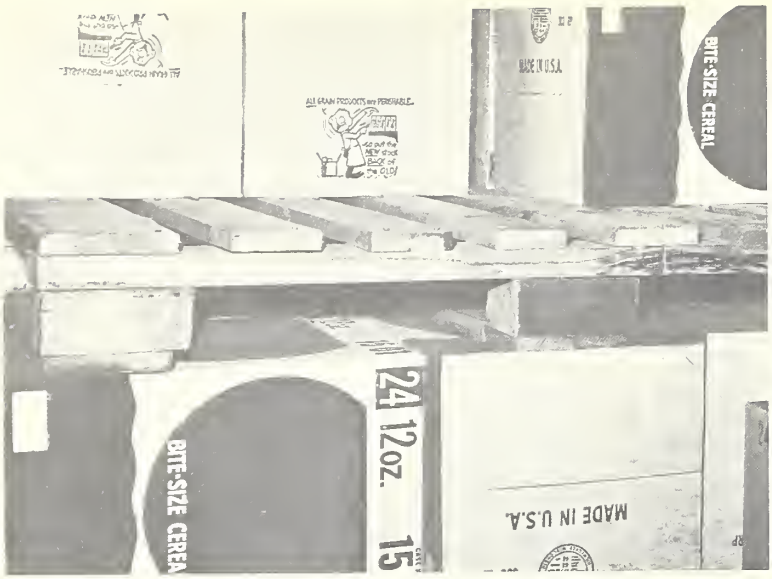
B. BN-21422

Figure 7.--(A) Metal guards used in one grocery warehouse for traffic corners; and (B) a closeup of the corner guards showing construction details.

A. BN-21424

B. BN-21429

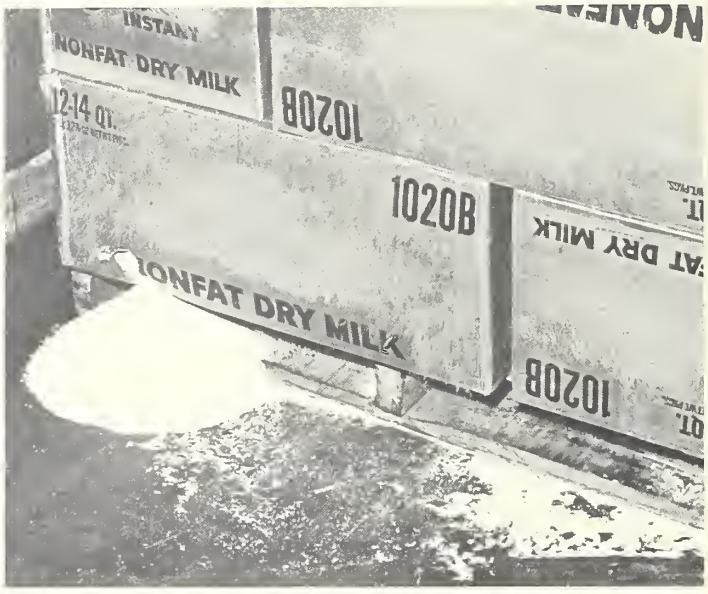
Figure 8.--Poor shipping container design. The dimensions of these cases do not permit the forming of a safe pallet block on standard-size pallets.



A. BN-21430

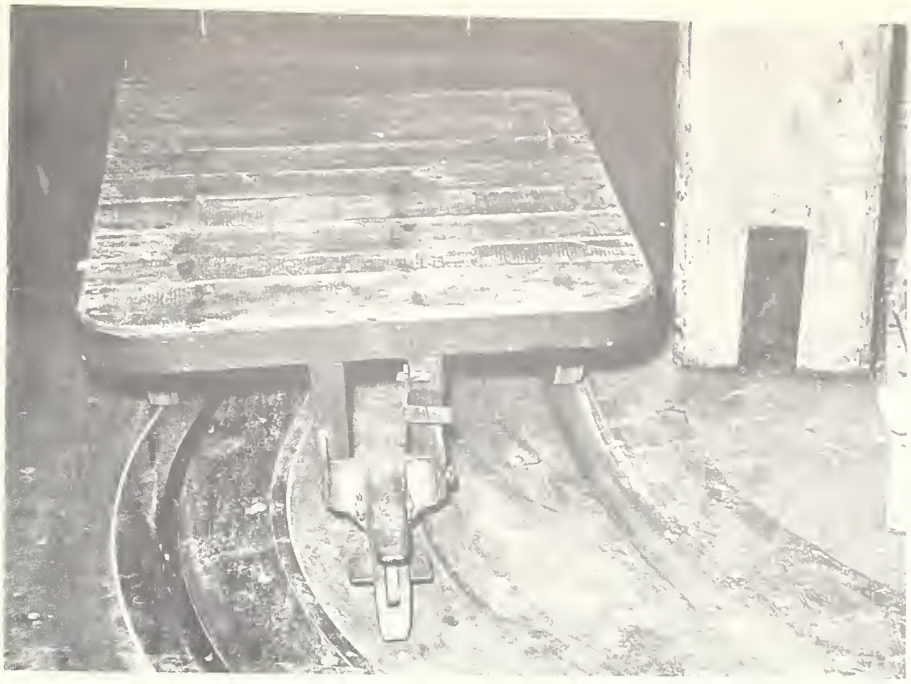
B. BN-21411

C. BN-21412



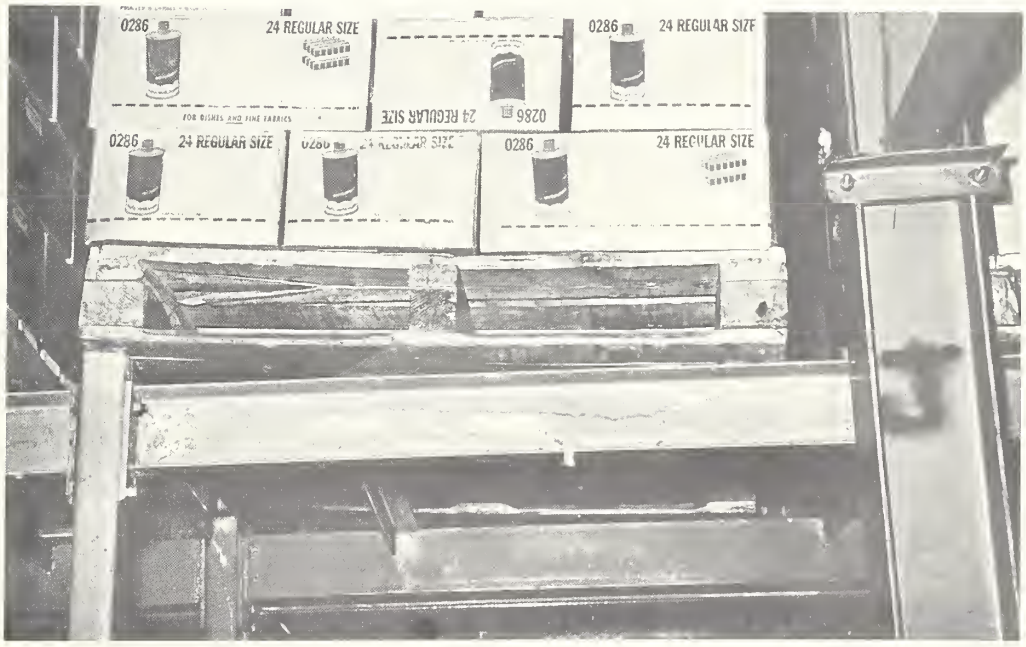
D. BN-21420

Figure 9.--Some examples of causes of warehouse damage: (A) Pallets of this type concentrate much weight on merchandise below; (B) insufficient clearances between pallets and columns; (C) insufficient clearance between pallets; and (D) forklift damage.



A.

BN-21751



B.

BN-21423

Figure 10.--Examples of poor engineering or "built-in" causes of damage: (A) Insufficient clearance between selector truck and column; and (B) poor rack installation.

Damage by commodities ranged from 1,700 cases of paper bags damaged per 100,000 shipped to 22 cases of canned items (table 4).

Table 4.--Breakage and damage related to movement for selected groups of grocery items in warehouse B during two 2-month winter periods 1/

Group	Damage first period	Damage second period	Total damage	Group movement for two periods	Damage per 100,000 cases shipped
High Incidence	Cases	Cases	Cases	Cases	Cases
Paper bags 2/	10	24	34	2,000	1,700
Oyster shell	6	15	21	2,000	1,050
Bagged salt	79	66	145	17,000	853
Bagged charcoal	27	2	29	6,000	483
Bagged flour	111	160	271	73,000	371
Bagged dogfood	22	19	41	12,000	342
Bagged sugar	46	88	134	40,000	335
Bottled items	183	159	342	190,000	180
Light bulbs	8	9	17	13,000	131
Total or average	492	542	1,034	355,000	291
Low Incidence					
Packaged soap powder	29	18	47	52,000	90
Cello-bagged items	17	0	17	28,000	61
Jar-packed items	104	53	157	289,000	54
Cereal, cold	34	23	57	116,000	49
Paper products	7	21	28	58,000	48
Paperboard items	67	117	184	482,000	38
Bar soap	2	3	5	17,000	29
Canned items	72	116	188	846,000	22
Total or average	332	351	683	1,888,000	36

1/ For convenience, "cases" is used to represent both fiber containers and bags.

2/ Brown paper bags for use in stores.

The high-incidence category in table 4 had damage of 291 cases per 100,000 cases shipped. The low-incidence category had damage of 36 cases per 100,000 shipped.

The movement of some items is subject to seasonal variation. The data reflect product movement during winter months; bagged charcoal, for instance, would have a significantly higher movement and more total damage during the summer season.

The damage reported in the first period was determined by recording each damaged item in the warehouse salvage area while the warehousemen were unaware of the study. Data were collected during the second period after a reporting procedure was developed and when warehousemen knew that the study was in progress. The total number of cases damaged in the two periods were practically identical, with an average of 100 cases damaged for every 100,000 cases shipped during both periods. The fact that the warehousemen knew the study was underway did not reduce the amount of damage. This could be interpreted that warehousemen were carefully handling merchandise, and the damage occurring was a result of factors beyond their control, such as poor shipping containers, warehouse layout, storage and handling equipment, and the procedures followed.

Recouping Losses Due to Warehouse Damage

The procedures used to recoup or reclaim the residual value of damaged merchandise varied in the three warehouses studied. These differences were due to the alternatives available to each firm. The choice of recouping alternatives depends on such things as type of organization and geographic location. The organizational differences have an effect on such possible courses of action as the following:

1. Allocation of damaged merchandise. Some chainstore organizations allocate damaged merchandise on a periodic basis to their retail outlets.
2. Assignment of damaged merchandise to one outlet.
3. Sales to salvage brokers.
4. Sales to cash-and-carry outlets.

The geographical location of the business has a bearing on alternatives for recouping certain classes of items. If it is close to a sugar refinery, damaged sugar may be re-refined. Bagged flour may be sold to a dogfood manufacturer, if one is nearby. Bagged salt may be returned to a public warehouse for replacement, if one is close. These activities also depend on the various manufacturers' policies. Not all manufacturers of the above-mentioned commodities, for instance, have such policies, and they may be different in each locale because of disposal or recoup alternatives.

Regardless of manufacturers' policies, a genuine and conscientious effort by those engaged in manufacturing and distribution toward better packaging, safer handling, or both, should significantly reduce damage losses.

Procedures in Warehouse A

A large percentage of damaged merchandise in warehouse A was repaired in a room at the rear of the warehouse. Because this warehouse supplied chain outlets, repaired cases were allocated to retail stores, which were required

to accept from 100 to 200 damaged cases periodically. The repairing in the salvage room consisted of opening cases, removing damaged units, inserting packing in space left by the removed units, and resealing the case. The number of undamaged units in the repaired cases was then written on the case with a black crayon. Items soiled by other broken units within the case often required washing. These items were repacked in either the original shipping cartons or other cartons provided for this purpose. Broken items packed in glass were placed in trash cans, and dented canned items were placed on shelving adjacent to the work area. Bagged merchandise in torn retail packages was placed in paper sacks, slightly larger than the retail package, and sealed with tape. Figure 11 shows a scene of recoup operations in warehouse A and the sink used for washing soiled items.

A BN-21417

B BN-21416

Figure 11.--(A) Processing damaged cases in warehouse A; (B) sink used for washing soiled items.

The bagged merchandise, dented cans, and loose units were sold to company employees at prices ranging from several cents off retail price to one-half the retail price. The sale was held weekly for about 5 groups of employees, each group having an opportunity to purchase damaged goods every fifth week. The sale of damaged goods to employees is a controversial subject among warehouse operators. Some operators feel that these sales may have a detrimental effect on the careful handling of merchandise.

A sample of 226 cases processed through the salvage room revealed that the average damaged case lost 25 percent of its wholesale value. In addition to the value loss, labor costs were incurred in the processing of warehouse damage. The labor costs, determined by time study techniques, indicated that under optimum conditions the operation of the salvage room would cost $102 weekly with these recouping policies. Labor to recoup merchandise damaged in transit to the warehouse was not charged to the salvage room operation, but was paid for by insurance companies. The average damaged case cost 27 cents to process, 5.4 percent of the average wholesale value of $5 per case (table 5).

Table 5.--Weekly time and cost of labor in salvage room of warehouse A 1/

Operation	Time per week	Labor Costs 2/
	Minutes	Dollars
Set case aside during order assembly or operation	72	3.00
Pick up case, place on handtruck	72	3.00
Hook on towline	6	.25
Remove from towline, push into salvage room	8	.33
Process packages - cans, 1.893 min. 69.0% glass, 2.905 min. 14.8% bags, 2.159 min. 16.2% 3/	787	32.82
Record for store allocation	175	7.30
Push truck out, hook on line	8	.33
Conduct sales to employees	355	14.80
Miscellaneous clean up and handle salvage	360	15.00
Miscellaneous paperwork and delays	596	24.85
Total per week	2,439	101.68
Total per case	6.5	.27

1/ Based on weekly breakage of 377 cases.
2/ At $2.50 per hour.
3/ The time required to process the three main items varied; thus, these times are weighted by the percentages of movement through the salvage room. The "average" item required 2.088 minutes.

Total costs amounted to 30.4 percent of the wholesale value--25 percent value loss and 5.4 percent labor cost.

Procedures in Warehouse B

The procedures followed in warehouse B, operated by a wholesaler with a voluntary group of supermarkets, differed from those followed in warehouse A. These differences were due, in part, to the few company-owned retail outlets; the firm was, therefore, limited in its ability to allocate distribution through retail stores. It had arrangements with some suppliers for recouping damaged merchandise.

Most damaged goods were sold to a salvage broker and subsequently resold to some retail outlets in low-income neighborhoods. The sale price to the broker was one-half of the regular retail value. Since the retail price was about 18 percent above cost, the net amount received for broker merchandise was 59 percent of the cost, or a loss of 41 percent. Some supply items, such as soaps and paper goods, were used within the distribution center, and some salable goods, such as store supplies, were sent to a cash-and-carry warehouse operated in another part of the city.

Damaged bagged flour was transported and sold to a dogfood manufacturer. The flour manufacturer paid the difference between the amount received from the dogfood company and the wholesale cost of the merchandise. Bagged salt was transported to a public warehouse and exchanged for new stock. Bagged sugar was transported to a sugar refinery and re-refined. Bagged dogfood was sold to a salvage broker. The major costs to the wholesaler for these items was the handling and the cost of transportation. The costs of recouping the bagged merchandise, therefore, depended on the frequency with which trips were made, since the warehouse paid the costs of transportation. No attempt was made to determine precise costs for this method of recouping. If we assume that the loss on the bagged goods was equal to the loss sustained on the merchandise sold to a salvage broker, this warehouse lost about 40 percent of the wholesale value of the damaged goods.

In addition to the loss in value, about 15 hours weekly were required to handle damaged goods and 5 hours for paperwork. Since 110 cases were damaged weekly, requiring $50 in labor, each case cost 45 cents in labor, or 9 percent of the wholesale value. Value loss and labor costs for these methods of recouping amounted, therefore, to 49 percent of the wholesale value--40 percent value loss plus 9 percent labor cost.

Warehouse A, with a loss of 25 percent of wholesale value and 5.4 percent in labor costs, recouped a larger percentage of the value of the damaged goods than warehouse B.

A judgment of whether warehouse A had a better recoup operation than B cannot be made, since warehouse B could not allocate to company-owned retail stores. The maximizing of returns from recouping operations thus depends on the alternatives available to a company with a given set of circumstances. Depending on local wage rates, extensive repair operations may not be justified in view of other alternatives of recouping.

Procedures in Warehouse C

The recoup operation in warehouse C consisted of collecting damaged goods at a specific location in the warehouse, recording the items, and shipping them periodically to a company-owned store, which processed and sold the damaged merchandise.

At the store, undamaged units were sold at regular price, and slightly damaged units at reduced prices in a special area on the sales floor. These damaged goods were charged to the retail store at one-half of the wholesale selling price. Management stated that this method of pricing resulted in an inventory gain at store level and a bookkeeping loss at the warehouse, but since this was a company store, company profits were not adversely affected.

Hidden Costs of Warehouse Damage

In addition to the labor costs of processing or disposing of damaged cases there are other costs:

- Delays of order selector, forklift driver, and truckloader due to re-handling and setting aside damaged cases.

- Time required to pick up and clean up damaged merchandise.

- Selection of cases to replace damaged cases discovered at the loading dock and handling damaged merchandise returned from transit.

- Administrative paperwork and activities concerned with allocation to retail stores, sales to salvage brokers, reimbursement from manufacturers, and recordkeeping, such as deducting damaged goods from warehouse inventories.

These items are not all-inclusive and will vary among firms, depending on the procedures followed. No attempt was made to isolate these costs; however, in total, they may be substantial.

Workplaces for Recouping Warehouse Damage

Observations of the workplace provided and the methods used for recouping damaged merchandise in warehouse A and in the store receiving unrepaired damage from warehouse C indicated that substantial improvements could be made, and costs of handling damaged goods reduced, by providing an improved workplace and adopting better work methods. While the operation in some warehouses required from one to two men full time, it was observed that little or no provision was made for the efficient performance of this function. In the operations observed, these deficiencies were noted:

- Work stations, when provided, were too high--40 to 45 inches--and too big-- 3 by 6 or 3 by 8 feet.

- Sinks were too deep and located too far from work stations; some had no hot water.

- Individual units were handled excessively in washing.

- Case cutting tools were generally inadequate.

- Excessive work was performed on the 4-wheel truck at poor working heights.

- Too many individual units were hand-carried to shelf or bin storage.

- Provision for trash and garbage disposal was inadequate.

- There were no floor drains for washing down the area.

- Lighting was poor.

- Storage for materials was inadequate.

- Frequently used materials were not conveniently located.

In order to improve the performance of salvage operations in warehouses allocating damaged merchandise to retail outlets, such as in warehouses A and C, an improved workplace consisting of a work station, conveyors, and a sink for washing soiled glass items was designed. The work station shown in figure 12 was designed to provide an adequate work surface at a height of 28 inches. This relatively low height allows the operator to inspect the contents of opened cases more easily than some of the tables customarily provided for this function. The working area was also held to the minimum necessary to perform the job. The tape dispenser may be mounted in the center of the table, as shown, for hand-operated models or on the corner for electric models operated by a foot pedal. Packing and other materials may be stored under the station or on wall shelving over the work station.

The sink shown in figure 13 has a drainboard with a splashboard at the rear and side. Some merchandise may be effectively cleaned by spraying, and this should be done either in the sink or on the drainboard with the items in wire baskets. A pistol-grip spray nozzle and hose should be provided at the rear of the sink. Merchandise requiring soaking may be placed in wire baskets and placed in the sink.

A layout for a warehouse salvage operation is shown in figure 14. In addition to the work station and sink other items required for the layout shown in figure 14 are:

Two 18-inch-wide, 10-foot-long skatewheel conveyor sections, one 90° curved section, and 6 H stands.

Garbage cans, as required.

A trash bin with wheels or constructed on a skid or pallet.

Floor drain, as shown.

Adequate lighting over the work station.

Case-opening tools--metal case cutters with heavy duty blades may be used. Wooden devices that can be used to pry open the glued flaps on cases without damaging the shipping containers also appear to be satisfactory.

Tote boxes should be provided for the temporary storage of odd units removed from the cases and to transport these units to the shelving area.

A shelf should be provided over the work station for storage of empty cartons.

Recommended Procedures for Operating a Salvage Room

Merchandise for processing should be obtained from the selector truck. Case opening, removal of damaged units, inserting of packing when necessary, and resealing should be performed at the work station. For items allocated to retail stores it is recommended that containers lacking a few units be rounded

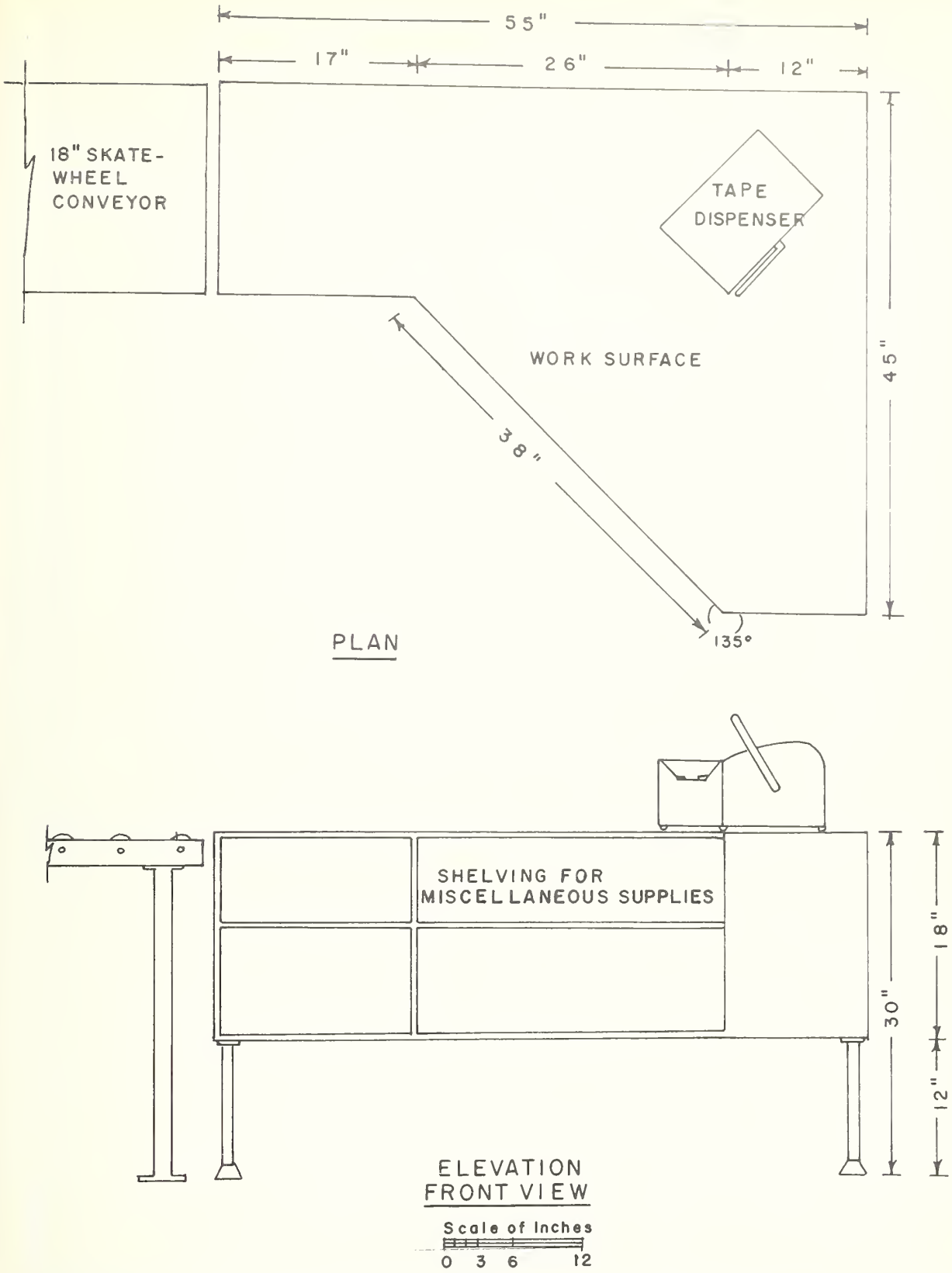


Figure 12.--A work station for repairing warehouse damage.

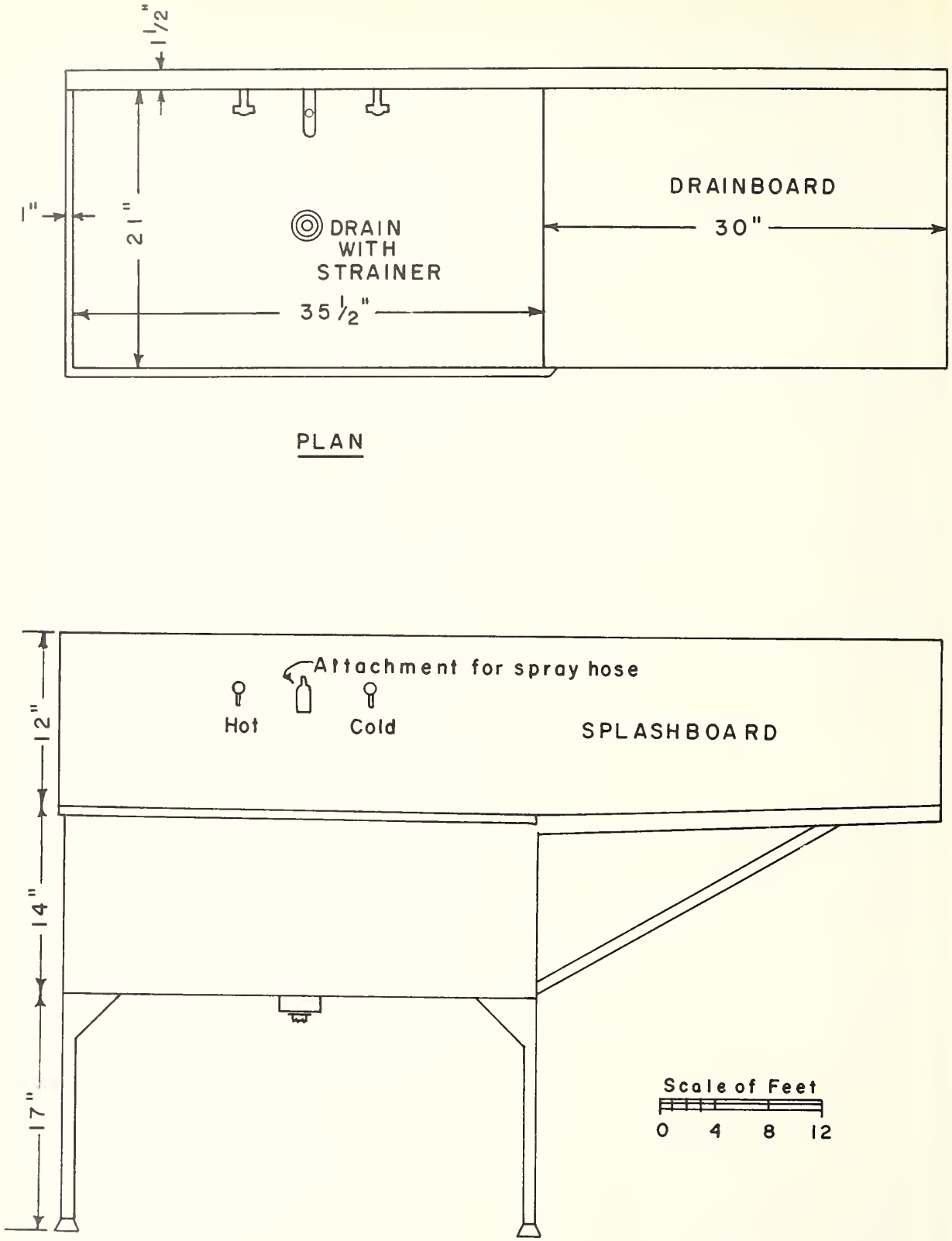


Figure 13.--A sink for warehouse salvage operations.

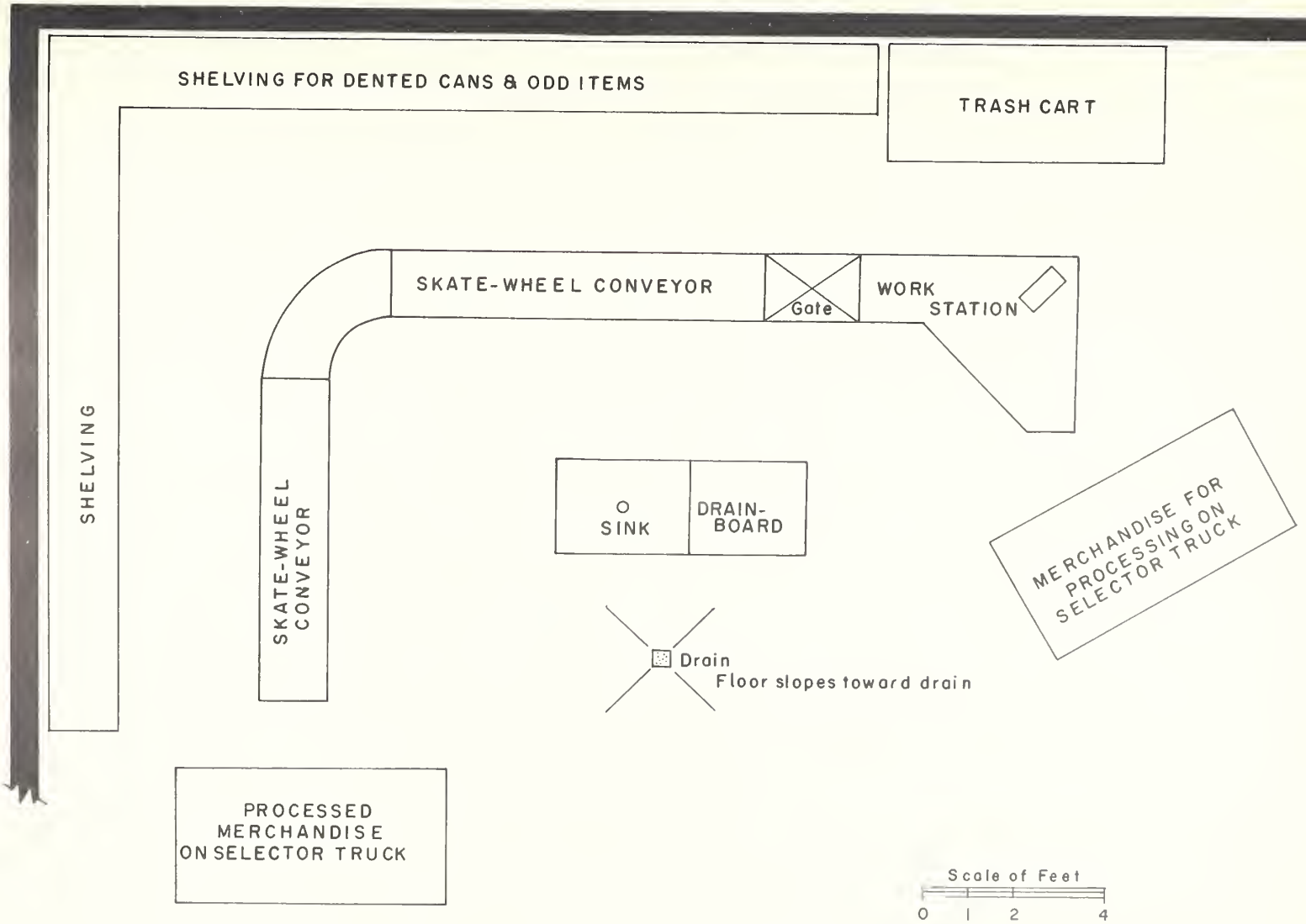


Figure 14.--A layout for a warehouse salvage operation.

out with whatever salable merchandise is on hand; for example, cans of tomatoes in cases of peas. This will reduce the inventory of odd units on hand. These units may be stored on shelving installed behind the take-away conveyor shown in figure 14.

To reduce the travel to the shelves to obtain these units, the cases requiring additional units may be left unsealed and placed on the take-away conveyor, and units may be added when the cases pass the shelving area. A small auxiliary tape dispenser may be installed at the end of the conveyor for sealing these cases. An alternative is to obtain odd units from the tote boxes at the work station. In this event the second tape dispenser would not be required.

TRANSPORTATION DAMAGE FROM WAREHOUSE TO RETAIL STORE

An indication of the extent of transportation damage from warehouse to retail store was obtained by keeping detailed records for 13 weeks. Although these data were kept in only one firm (warehouse A), they covered the movement of over two million cases. Transit damage during this period amounted to 169 cases, or 8.3 cases per 100,000 shipped.

The 169 damaged cases were classified into 11 separate categories to determine the categories most affected by transit damage. A distribution of this damage showed that bagged flour accounted for 35.5 percent, bagged salt 20.7 percent, bottled items 12.4 percent, and jar-packed items 10.1 percent of the transit damage (table 6).

Table 6.--Cases of selected grocery items damaged in transit during a 13-week period in warehouse A

Commodity	Cases or bags	Proportion of total
	No.	Percent
Bagged flour	60	35.5
Bagged salt	35	20.7
Bottled items	21	12.4
Items in jars	17	10.1
Canned items	14	8.3
Paperboard-packaged items	9	5.3
Bagged sugar	8	4.7
Bagged charcoal	2	1.2
Bagged dogfood	1	.6
Cold cereals	1	.6
Items in cello packages	1	.6
Total	169	100.0

An examination of the 169 cases damaged in transit showed that more damage per case occurred in transit than in the warehouse--a loss of 40 percent of wholesale cost after recouping, compared with 25 percent for warehouse-damaged goods. Of the 169 cases damaged in transit, 106, or nearly 63 percent, were bagged flour, salt, sugar, charcoal, or dogfood. These items accounted for only about 8 percent of the warehouse movement.

Observations of truckloading procedures in the warehouse revealed that truckloaders devoted special attention to protecting the bagged merchandise. Cardboard was placed on the trailer floor for bagged items, and cardboard was inserted between rows of bagged merchandise and the other cases. Warehousemen stated that this procedure had reduced bagged item damage.

RETAIL FOOD STORES

Studies were made to determine causes and measure the extent of damage at store level. The studies were made in four supermarkets of one firm in the upper Midwest and in one store of another chain in upstate New York. Total store sales for these five supermarkets ranged from $30,000 to $60,000 a week. These stores were chosen because each represented a different type of receiving or price-marking operation; hence, the data gathered indicate problem areas in different types of operating situations. This section includes some analysis of these problem areas, together with some recommendations for reducing store damage.

The five stores selected for study used the following handling procedures:

Store A received by conveyor in a storeroom on the perimeter of the building. Items were priced by a 3-man crew during receiving.

Store B used pallets, a pallet jack, and a dock for receiving. Items were processed on a conveyor by a 3-man crew.

Store C used pallets, a pallet jack, and a dock for receiving. Items were priced at the shelf during the stocking operation.

Store D received in a basement storeroom by conveyor. Items were priced at the shelf during the stocking operation.

Store E received from the trailer by conveyor and a metal-lined chute attached to a conveyor in the basement. Items were priced after receiving, as needed, on the conveyor.

All stores except C, which stocked from pallets, used 4-wheel or 6-wheel handtrucks to transport merchandise to the shelf. Stores D and E used powered conveyors to move cases from the basement to the sales floor.

Forty-seven causes of damage were reported in the five stores studied. Some causes were common to all five; others were unique to a given store. Of the 47 reasons, 10 common to all 5 stores accounted for 62 percent of the total identified damage; 37 causes unique to individual stores were responsible for an average of 38 percent of the damage (table 7).

Table 7.--Number of units damaged by common and unique causes in 5 supermarkets

Store	Units damaged			Proportion of identified damage	
	Common causes	Unique causes	Total identified causes 1/	Common causes	Unique causes
	No.	No.	No.	Percent	Percent
A	224	118	342	65.5	34.5
B	103	56	159	64.8	35.2
C	224	96	320	70.0	30.0
D	225	175	400	56.2	43.8
E	129	109	238	54.2	45.8
Total or average	905	554	1,459	62.0	38.0

1/ Total damage from identified causes represents damaged items for which causes were established and does not include "spoiled," "missing labels," "concealed damage," or "out-of-date merchandise."

Causes of Damage Common to Supermarkets

The damage from common causes ranged in importance from 281 items damaged by case cutter, or 19.3 percent of the total damage in the five stores, to 26 items, or 1.8 percent for "dropped case while taking it from stock." The 10 common causes of store damage may be broadly divided into two groups: Damage caused by employees, 36.7 percent of the total damage, and damage caused by customers, 25.3 percent (table 8).

Table 8.--Grocery items damaged by causes common to five supermarkets 1/

Reason	Units damaged	Percent of total damage
	Number	Percent
Carton damaged by cutter blade during cutting of case	281	19.3
Dropped by customer	149	10.2
Fell off shelf when disturbed by customer	137	9.4
Unit dropped during stocking of shelf	94	6.4
Stack fell over in backroom	60	4.1
Merchandise crushed in stack	44	3.0
Broken or crushed in shopping cart	42	2.9
Dropped by customer unloading shopping cart	41	2.8
Units fell out of open or torn shipping container	31	2.1
Dropped case while taking it from stock	26	1.8
Total 2/	905	62.0

1/ See appendix table 14.
2/ Exclusive of "spoiled, missing labels, or concealed damage."

The common causes, as in the warehouse studies, offer the most potential for damage reduction. Corrective measures at the warehouse level, directed towards both common and unique causes in any given firm, are relatively easy to adopt and supervise. Store improvements require more effort, and more expenditures, mainly because a firm has more stores than warehouses.

Cartons or packages damaged by the cutter blade during case cutting amounted to 19.3 percent of the total damage for all items in the five supermarkets. The items in paperboard containers were affected more than any other merchandise group. Exclusive of "concealed" and "spoiled" damage, case cutting

accounted for 43 percent of the damage to such items as cake mixes, cookies, soap powders, dry detergents, and hot and cold cereals (figure 15). A review of case-cutting procedures revealed that some of the causes of damage were:

● Lack of instruction in cutting techniques. Often new store employees received little or no instruction in techniques of pricing and shelf stocking and merely "picked it up" on the job. It is recommended that new employees be assigned to work with a competent stock clerk capable of teaching the correct techniques. Making store employees more damage conscious can also be included in company work simplification programs.

BN-21413

Figure 15.--A retail package damaged by cutting through the shipping container.

● Using the half-case method of price marking on damageable merchandise. Unless there are important reasons in an individual store for pricing multi-layer cases of packaged items in the stockroom, it is recommended that these items be priced at the shelf. On certain items such as soap powders and dry detergents, the "X" method of cutting cases may reduce case-cutting damage since the tops of these retail containers are of double thickness. If the blade length is properly regulated it will not penetrate the package because of this thickness. When using the "X" method, the blade is adjusted to the

thickness of the case top and two diagonal cuts are made from corner to corner of the case; the four triangular flaps thus formed are then opened.

• Improper case-cutting tools. Some of the case cutters were razor blade holding devices about $3\frac{1}{2}$ inches long. This type of cutter, often furnished at no cost by company suppliers, is inadequate. Because of its narrowness, the holder as well as the blade sometimes pierces the shipping container, causing a deeper cut than desired and cutting into the retail package. There is no provision, for maintaining the correct cutting length of the blade. The tool does not fit the palm of the hand comfortably and requires excessive finger pressure. The narrowness of the device puts undue force against one spot on the index finger, causing soreness and bruising. Some employees were observed using single-edge razor blades without any type of holding device. This should be forbidden, since the depth of the cut cannot be controlled, and it is dangerous.

A well-designed case cutter should have the following characteristics:

1. A holder broad enough (at least 1/8 inch) on the cutting end to prevent it from penetrating the shipping container. It should comfortably fit the palm of the hand.

2. A locking device to ensure proper adjustment of blade length. This device should be easily controlled with the fingers; additional tools should not be required to adjust blade length or retract the blade.

3. Capability of using heavy duty industrial-type blades that will not break when encountering staples in the shipping container. Some devices use single-edge razor blades, which are satisfactory except for the short blade life. Single-edge blades for commercial use, generally factory rejects, are available for less than one cent each, whereas the heavy-duty blades cost about 5 cents each. If the store is supplied with commercial-use single-edge blades, (and, more important, if employees use them) they may prove less costly than the more expensive heavy-duty blades. The problem becomes one of management to ensure that blades from shelf stock, which often cost as much or more than the heavy industrial blade, are not used. One advantage of the industrial blade is that it can be resharpened; however, at a wage rate of $2 per hour, or 3.3 cents per minute, it is not economically feasible for employees to resharpen these blades.

4. The cutter may be equipped with a retractable guide which will overhang the top of the case and enable the operator to maintain an upward pitch on the blade (downward on the handle), thus avoiding contact with the tops of the retail packages.

For items displayed on trays made from the shipping container, the cutter should be equipped with guides to facilitate cutting the sides of the trays evenly. Figure 16 shows a case cutter designed to cut both bottom and top trays. Since some merchandise requires a higher lip on the tray for rigidity, it is desirable to have several cutters designed to cut various heights. These heights may be $\frac{1}{2}$ inch, 1 inch, and $1\frac{1}{2}$ inches. Cutting trays from cases is best performed at a backroom work station consisting of either a 24-inch by 30-inch

table or a metal conveyor plate 18 by 30 inches. A flat working surface is necessary to support the bottom guide of the cutter and facilitate even cutting of the tray.

Because of possible damage to the retail containers, caution should be exercised when cutting cases for trays for such items as sugar in cartons, cake mixes, cereals, and soap powder. A safe procedure for making a tray for packaged items in a single-layer case is:

Remove case top.

Turn case over and let packages slide out until they protrude about 3 to 4 inches.

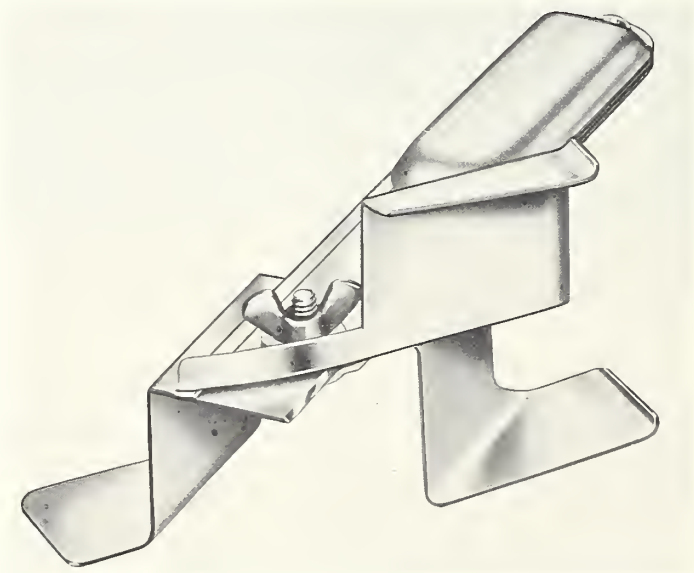
Cut tray, reposition on merchandise.

Turn case over, remove sleeve.

Stamp price on units.

While tray packing will save about 2 cents in handling the average case, one packaged item damaged by the cutter and resulting in a loss of 10 cents will offset the savings on five cases of tray-packed merchandise. 10/

10/ The average case had 26 retail units. Sixty-nine percent of all cases were multilayer and 31 percent single layer.



BN-21426

Figure 16.--One type of case cutter equipped with guides for cutting the cases so they can be used as trays for the packages.

Items dropped by customers and falling off the shelf when disturbed by customers amounted to 10.2 and 9.4 percent, or a total of 19.6 percent of the total damage in the five stores. The items most affected by this damage were packed in jars and bottles, and the damage can be attributed to three causes: (1) Customer carelessness, (2) display building and stocking techniques which contribute to damage by customers, and (3) lack of store and equipment planning designed to reduce damage.

Haphazard stocking, with bottles or jars overhanging the shelf edge, contributes to breakage. Another quite common cause is the placing of leftover units on their side on top of tiered items (fig. 17).

BN-21425

Figure 17.--An example of leftover units laid on their sides on top of tiered items.

When shelf space is allocated according to movement of stock, sufficient space should be provided to handle sales without laying units on their sides. If not, provision should be made for restocking to handle heavy weekend business. One remedy is the use of shelving that slants toward the rear of the gondola, particularly in glass-packed merchandise sections. The placing of a lip on the shelf edge appears to be a sound practice. Some firms are installing shelf railing about 3 inches high for such items as bottled bleach and ammonia. This precaution costs very little and seems to be worthwhile. Some firms are installing rubber matting or other materials in front of glass-packed merchandise. This seems to be particularly desirable in stores with concrete or other hard floors.

In order to justify damage-reducing expenditures, it is necessary to reduce damage and labor costs due to damage at least equal to the cost of the improvement. High-volume stores may well be justified in making such expenditures whereas low-volume stores may not. For example, store D, with average weekly sales in 9 weeks of $50,000, had a complete loss of 97 bottled and jar-packed items dropped at the gondola or the checkout counter or knocked off the shelf by employee or customer activity. The 97 items, with an average retail value of 37 cents, amounted to a value loss of $35.89. In addition to this loss, it is assumed that this type of damage required at least 5 minutes of store labor per item damaged. Labor associated with this breakage for sweeping and cleaning up would cost 17 cents per item, or an additional $16.49, for a total loss of $52.38, or $303 annually. 11/ Total elimination of these types of damage through these suggested procedures is improbable. If a 50-percent reduction is assumed, then actual savings for this store would amount to

11/ Labor at $2 per hour.

$151.50 per year. This potential saving should then be considered in relation to the cost of installing matting in front of danger areas.

The provision of dividers or separators between layers of double-stacked glass items will also reduce damage, and it is recommended that dividers of various widths be provided for this purpose. Some firms are using thin gage fiberboard for such double-stacked items. Many manufacturers are also becoming more "retail minded" and packing items in glass jars that will safely stack (fig. 18).

BN-21427

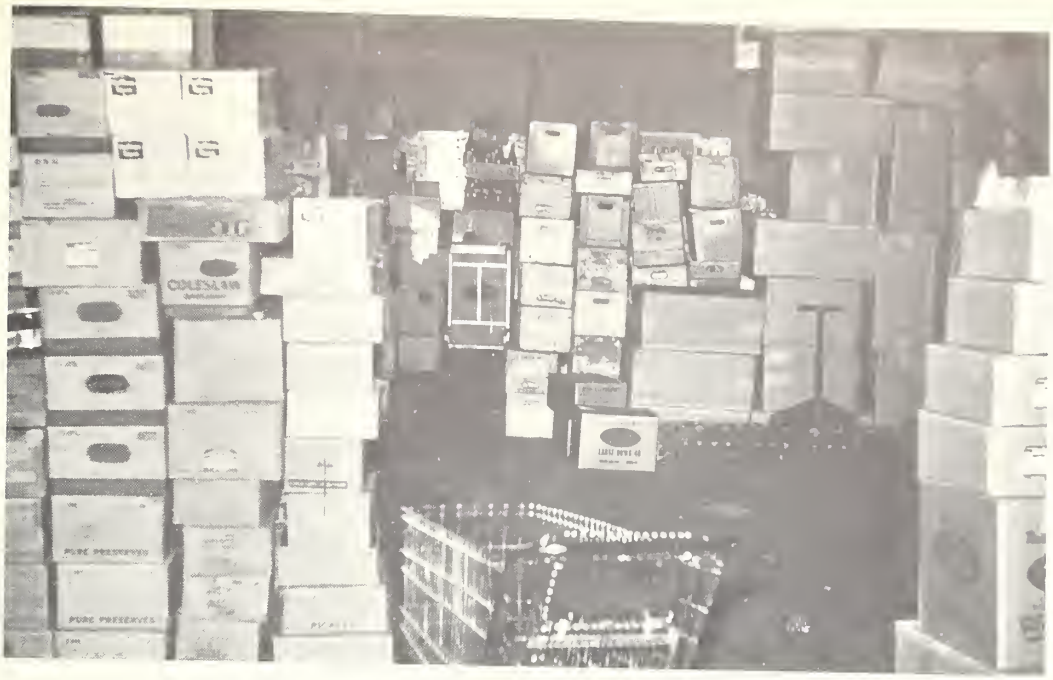
Figure 18.--A recess in the jar has been provided so that these jars may safely double stack on the shelf.

Dropping units while stocking shelves caused 6.4 percent of the total damage. One major cause of this type of damage, other than the difficulty of safely stacking glass items, is due to the stocking techniques used. If the case is not positioned on the side of the handtruck nearest the operator, or if pull-out case supports have not been provided on which to position the case, the clerk will invariably rest the bottom of the case on the edge of a lower shelf and hold it there with his knee or some other part of the body. This is a risky procedure for glass-packed merchandise. In stacking glass-packed merchandise the clerk should take units from opposite sides of the case simultaneously to prevent the concentration of weight in one end of the case. The concentration of weight often causes the case to tilt and fall. Because this occurs suddenly, it is difficult to catch the case. 12/

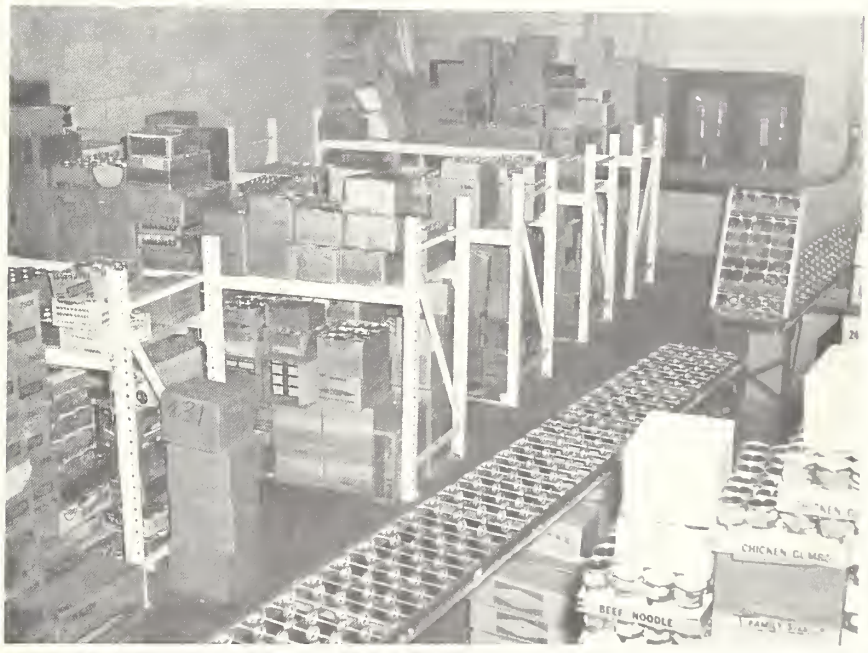
Stacks falling over in backroom; merchandise crushed in the stack; and cases dropped while being taken from stock were responsible for 8.9 percent of the damage and are related to poor backroom storage procedures. Damage from these causes ranged from 2.7 percent of all damage in store A--a store that received by conveyor, and had some storage racks--to 14.0 percent in store C--a store that received on pallets and had only two storage racks for partial cases. The use of storage racks to insure orderly storage is recommended (fig. 19).

A shelf installed against the wall above the receiving conveyor is also recommended for the storage of small and lightweight items. An orderly storeroom layout with all merchandise in proper locations, clearly defined and

12/ For further details on the use of the pull-out case support, see Harwell, E. M., and Shaffer, Paul F. Some Improved Methods of Handling Groceries in Self-Service Retail Food Stores. U.S. Dept. Agr. Mktg. Res. Rpt. No. 7, 118 pp., May 1952.



A. BN-21428



B. BN-21414

Figure 19.--A grocery storeroom (A) before and (B) after installing storage racks.

maintained traffic lanes, and good housekeeping are prerequisites for holding storeroom damage to a minimum and also to the efficient operation of the grocery department (fig. 20).

Merchandise broken or crushed in shopping carts and dropped by customer in unloading the cart accounted for 5.7 percent of the damage. This damage appears to be due to customer carelessness. Improved shopping cart design may help to hold this damage to a minimum. The provision of trays on the bottom of shopping carts to hold heavy items seems to have merit in reducing damage due to crushing. A divided shopping cart to separate heavy from light merchandise may also reduce the damage. As most operators are aware, shopping-cart damage is not confined to the dry grocery department and may affect any fragile merchandise.

Units falling out of open or torn shipping containers accounted for 2.1 percent of the damage. The bagged merchandise was affected more than any other merchandise group. It is recommended that such items as bagged sugar, flour, dogfood, and charcoal be unloaded immediately inside the receiving door to reduce the distance traveled on the conveyor. Another recommended procedure, especially if there is any dampness in the storeroom, is to store this merchandise on platforms several inches from the floor to prevent moisture damage. Some stores request wooden pallets from the warehouse for this purpose.

One practice to be avoided is the splitting of single-layer cases of glass-packed merchandise into half cases. Merchandise handled in this manner is highly susceptible to damage. Shelf space should be provided to hold a full case, plus several units for reserve. Product movement analysis reveals that for many items less than a full case per week is sold. Because of relatively low movement for many items, it is unnecessary to have more than four or five units above the full case quantity on the shelf, especially when shelves are stocked several times each week. This method of space allocation will reduce breakage and also the costs of price-marking and shelf stocking glass-packed items.

Causes of Damage Unique to Individual Stores

The unique causes of damage in the five stores accounted for damage to 554 units, or 38 percent of all damage. 13/ During the study it became obvious that shortcomings in engineering and other built-in causes of damage existed to varying degrees in each store. Furthermore, some store managers claimed that inadequacies reported to higher levels of management had little effect in bringing about corrective action. The fact that some of these built-in inadequacies cause damage losses for the entire life of the store should motivate store engineering departments to provide necessary safeguards wherever possible.

13/ The percentages given for each store are based on the total recorded damage in that store exclusive of "spoiled, missing labels, or concealed damage."

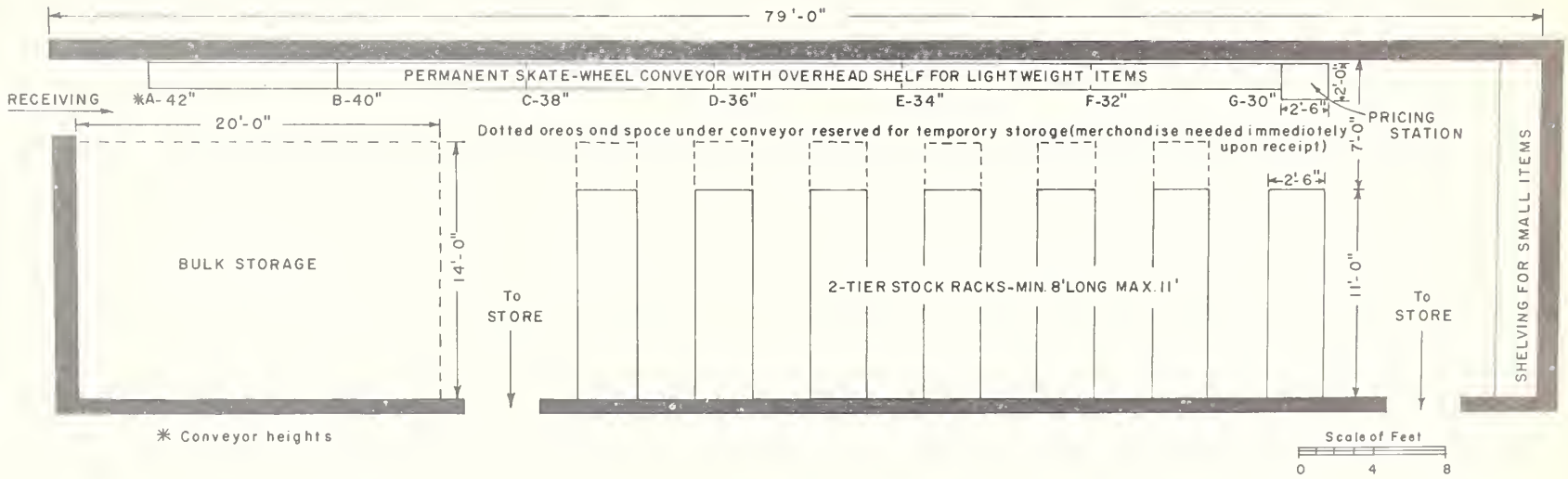


Figure 20.--A recommended storeroom layout for a grocery department with a volume of $25,000 per week and four weekly deliveries.

Store A

The most important of the unique causes of damage in store A centered around the methods and equipment used for receiving. 14/

Falling off the conveyor from the trailer, falling off or crushed by jam-up on conveyor, and dropped while being put away caused 13 percent of all damage in store A and were due to--

- Cases falling from the narrow 10-inch conveyor used for receiving.

- Cases frequently colliding with the guard installed on a right-angle conveyor curve in the storeroom.

- The combined receiving and pricing operation used by store A. The truck driver loaded cases on the conveyor in the trailer; one store employee cut these cases open on the conveyor in the storeroom; one stamped retail prices on the merchandise; and another placed these cases, as well as cases not stamped, in rows at right angles to the conveyor. The retail price of the merchandise had previously been written on the cases at the warehouse. Because loading cases on the conveyor in the trailer required about half as much time as the processing of the merchandise, the driver was constantly ahead of the receiving-pricing crew. This resulted in merchandise piling up on the conveyor, causing cases to fall or be torn.

The damage in this store could be reduced by--

1. Using an 18-inch conveyor.

2. Either eliminating the conveyor curve or installing adequate guards and banking the conveyor curve.

3. Unloading bagged merchandise immediately inside the receiving door.

4. Either eliminating the combined receiving-pricing operation or having the driver place cases on the conveyor only when requested by store employees.

Store B

Dropped while being put away during receiving was the only significant unique cause of damage in store B. It accounted for 11.3 percent of the damage. Observations of the pallet-receiving operation revealed that insufficient storeroom space was provided for the temporary storage of loaded pallets. Unstable pallet loads caused merchandise to fall from the pallet, especially while the pallet was moving over the dock plate from the trailer.

In the first instance, storeroom space should be cleared before receiving to store the incoming load. This space can be clearly defined by painting

14/ See appendix table 14 for the distribution of damage in each store.

yellow guidelines or by using tape on the storeroom floor. If the merchandise is shipped in a 35-foot trailer, 14 pallet spaces should be provided. To reduce damage in transit and also during receiving of merchandise shipped on pallets or skids, some firms use tape to secure the top of the pallet load. This seems to be particularly desirable for lightweight cases, which often shift on the pallet during transit.

Store C

The most significant unique causes of damage in store C occurred during stocking activities. Broken while taking down display, dropped whole case while shelving units, and broken while building end display accounted for 8.4 percent of total store damage. The two causes concerned with end display activity indicate that poor procedures were being followed.

One cause of display damage was the lack of adequate dividers between tiers of glass items. Another poor procedure was the use of tray-pack end displays with inadequate lips on the trays, often only one-fourth inch high. This height does not provide the tray enough rigidity to insure safe handling during erecting and taking down of end displays. Insufficient lip height also contributes toward tray-pack damage in gondolas, especially when merchandise is being rotated.

A lip at least 1-inch high is recommended for most tray-pack items. The use of the pull-out case support will reduce damage caused by dropping cases during stocking.

Store D

The significant unique causes of damage in store D were due to a poor conveyor installation. Fell off conveyor from trailer; fell off conveyor going to basement; and fell off or crushed by jam-up on conveyor accounted for 28.4 percent of the total damage.

The primary cause of the high amount of damage for the first two reasons was that the gravity roller conveyor from the trailer was connected directly to the basement powered-belt conveyor installed in a stairwell at an angle of about 45 degrees. Cases traveled considerably faster on the roller conveyor than on the powered-belt conveyor. Because of this and also because the belt conveyor was pitched more steeply than the roller conveyor, cases sometimes tumbled down the belt conveyor. The installation of a short, level belt conveyor between the roller conveyor and the belt conveyor would reduce the momentum of the cases, and reducing the pitch of the belt conveyor in the stairwell would substantially reduce the tendency for cases to tumble.

Damage from jam-ups on the gravity conveyor in the basement was due to excessive speed on the half of the conveyor that sloped downward and loss of momentum after the merchandise reached the last half, which was level. The merchandise jammed up on the level section (fig. 21). While gravity should be used to move merchandise on conveyors whenever possible, often conveyor

installations of 100 feet or more in length require a powered booster section to operate properly. Booster sections in these situations will reduce jam-ups and also reduce damage due to impact.

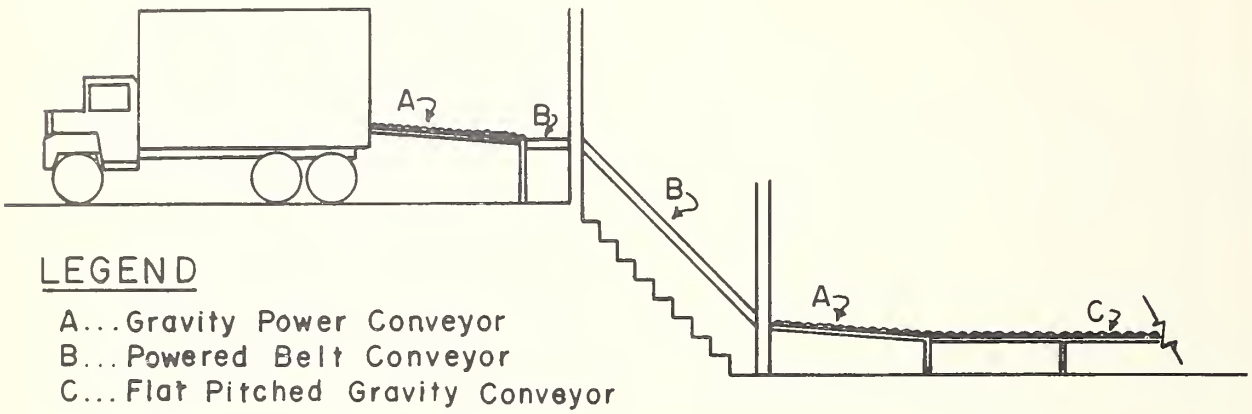


Figure 21.--The conveyor installation in store D.

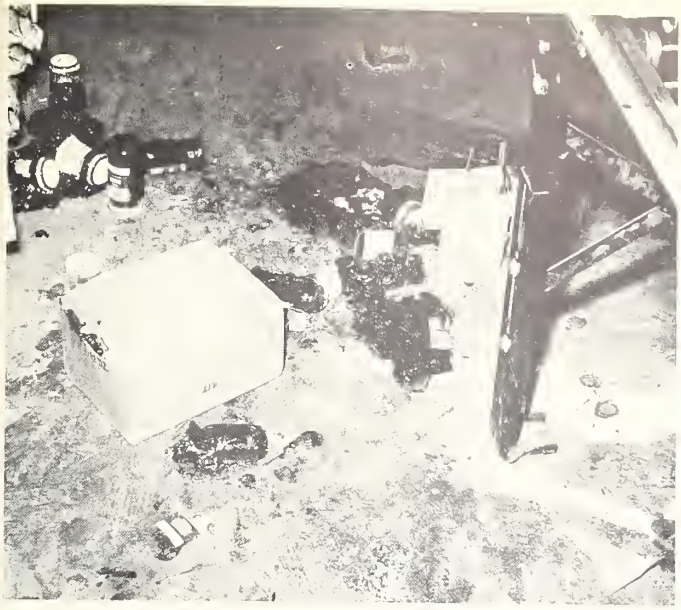
Store E

The major unique causes of damage in store E were very similar to those in store D, which also received merchandise in the basement. Fell off conveyor from trailer; fell off conveyor going to basement; and fell off or crushed by jam-up on conveyor accounted for 38.8 percent of the total damage. The major cause for damage due to the first two reasons was similar to that in store D; however, this store used a chute instead of a power conveyor to transport cases to the basement. The recommendation in this instance would be the replacement of the chute with a powered belt conveyor equipped with a take-off section at the trailer end. Damage due to jam-ups on the conveyor may be reduced by the installation of an additional power section in the storeroom. The justification for these improvements depends not only on their reducing damage, but also in labor savings, since cases need not be pushed by hand. Figure 22 shows some poor practices that are obvious causes of damage.

Items Affected by Store Damage

In the five stores, 4,111 units were recorded as "damaged, spoiled, or missing labels." This loss ranged from 48.8 percent of all loss for canned items to 0.1 percent for bagged charcoal (table 9).

Since the percentages of damage reported may be the result of normal damage and high movement, the main contribution of these data is to indicate the composition of, or items most affected by, store damage.



A. BN-21431

B. BN-21432

Figure 22.--Example of store damage and a cause of damage: (A) Results of double-stacking cases on conveyor; (B) improper repacking of glass-packed items.

Recoup Procedures

An indication of the loss from damage and spoilage was obtained from records kept in stores A, C, and D, for 2 months.

Partially damaged items were sold weekly to store employees for one-half of the retail selling price. Completely damaged goods were discarded. Following these procedures, damage loss amounted to 0.089 percent of grocery department sales in three stores. A measure was also obtained of item spoilage, such as swollen cans, discolored glass-packed items, spoiled candy, and other spoiled items. Spoilage loss amounted to 0.017 percent of grocery sales. On the basis of grocery item movement, 15 items were damaged and one item was spoiled for every 25,000 items sold, a ratio of one spoiled item to every 15 damaged. 15/ Manufacturers redeemed 14.5 percent of the loss on damaged and spoiled items (table 10).

There was a considerable difference in the amount of spoilage reported by store A, compared with stores C and D. There was no apparent reason for this difference. There was also a considerable difference in redemption by manufacturers. Store C was very zealous in saving labels for credit and recouped a larger share of losses through this effort.

15/ Based on 26 items to the average case. An item represents an individual can, jar, bottle, or package.

Table 9.--Units of selected grocery items damaged in five supermarkets in a 2-month winter period 1/

Item	Units damaged	Proportion of total damage
	No.	Percent
Canned items	2,009	48.8
Items in paperboard packages:		
Cake mixes and cookies	460	11.2
Cereals	137	3.3
Soap and detergents	122	3.0
Total	719	17.5
Items in paper bags:		
Sugar	176	4.3
Flour	93	2.2
Dogfood	19	.4
Salt	8	.2
Charcoal	2	.1
Total	298	7.2
Miscellaneous:		
Bottled items	293	7.1
Items in jars	288	7.0
Items in plastic or cellophane bags	121	3.0
Candy - All packs	115	2.9
Other items	268	6.5
Total	1,085	26.5
Grand total	4,111	100.0

1/ Tables 15 through 20 show the causes of damage to these selected groups of items.

Store D had almost twice as much damage as stores A and C, 0.13 percent of grocery department sales, compared with 0.06 and 0.07 percent in stores A and C. This was probably due in part to the basement conveyor in store D, since 28.5 percent of the damage was attributed to the basement conveyor used. This type of damage is not unusual in stores using basement storerooms. In addition to the value loss on damaged goods, an average of 2 minutes per item damaged was required to sweep up, mop up, handle damaged items, and transact sales to employees. Labor for these functions amounted to 0.01 percent. Total labor and value loss from damage averaged 0.10 percent of grocery department sales.

Table 10.--Percentage of damage and spoilage losses redeemed by manufacturers or absorbed by retailers in three supermarkets

Store	Absorbed by retailers		Redeemed by manufacturers	Total
	Net damage loss after recoup	Net spoilage loss after recoup		
	Percent	Percent	Percent	Percent
A	64.7	29.6	5.7	100.0
C	61.8	9.8	28.4	100.0
D	81.1	9.6	9.3	100.0
Average	69.2	16.3	14.5	100.0

It is recommended that damaged merchandise at the store be collected at a central point in the storeroom and periodically processed or otherwise disposed of. If a central point is not provided and a procedure for disposal established, these accumulated products hinder backroom efficiency and also contribute toward further breakage (fig. 23).

LOSSES DUE TO DAMAGE

Based on data gathered in the firms studied, it is estimated that losses due to damage in grocery warehouses, in transit, and at store level range from $30 million to $50 million annually (table 11). This estimate assumes that many operators are absorbing higher losses than the firms studied. Many firms were visited, but those selected for study used above-average equipment and methods.

BN-21435

Figure 23.--A collection point for damaged merchandise.

Table 11 indicates that 73 percent of the loss due to damage occurs at store level. This should be qualified, however, since 35 percent of the damage reported at store level was classified as "concealed." While it can be assumed that some of this damage actually occurred during receiving or backroom handling, part of this 35 percent was concealed damage that occurred before delivery. Remedial measures taken at the warehouse and in delivery vehicles will reduce the amount of concealed damage at store level.

Table 11.--Total estimated loss in the United States due to breakage and damage in grocery warehouses in transit between warehouse and store, and in stores in 1962 1/

Item	Percent of dry grocery sales 2/	Annual loss	Percent of total loss
	Percent	Dollars	Percent
Loss of value due to warehouse damage 3/	0.0250	$6,325,000	17.6
Loss of value due to transit damage 4/	.0034	860,200	2.4
Warehouse recoup labor for warehouse and transit damage 5/	.0106	2,681,800	7.4
Damage loss at store 6/	.0890	22,517,000	62.5
Recoup labor at store 7/	.0144	3,643,200	10.1
Total estimated loss	.1424	$36,027,200	100.0

1/ Does not include store damage to outside vendor items.

2/ Based on total retail food store sales for 1962 of $56.2 billion and estimated dry grocery sales of 45 percent, or $25.8 billion. (See footnote 2, page 4.)

3/ Based on a damage rate of 1.5 cases per 1,000 handled, loss of cost value of 25 percent. Does not include damage in institutional warehouses.

4/ Based on a damage rate of one case per 10,000 shipped, loss of cost value of 34 percent.

5/ Based on warehouse recoup procedures in warehouse A.

6/ Based on loss of $\frac{1}{2}$ retail price on 84 percent and complete loss on 16 percent of damaged items.

7/ At 2 minutes per item damaged, including clean up, paperwork, and sales to employees.

METHODS

The causes of warehouse damage were determined by a reporting procedure in three grocery warehouses. In warehouse A salvage room personnel toured the warehouse several times each day and collected damaged merchandise. Whenever the cause of the damage could be ascertained with a reasonable degree of certainty, a code number corresponding to a damage cause was written on the case. Later, during the salvaging operation, the damage was recorded and the code number listed.

The reasons were divided into four general groups based on warehousing activities in order to facilitate matching a given reason with its corresponding damage code number.

Group 1 - Receiving, travel to storage, and slot replenishment

Group 2 - Order selection and travel to shipping dock

Group 3 - Shipping dock and truck loading

Group 4 - Other reasons

In warehouses B and C the reporting procedure involved not only salvage personnel, as in warehouse A, but also the loaders, unloaders, forklift operators, and order selectors. These men were instructed to help identify the causes of damage by writing the damage reason number on any merchandise damaged within their area of activity. Records of shipments were also maintained in all three warehouses in order to obtain a measure of the extent of damage.

Item movement was established in one warehouse through the use of automatic data processing equipment, and individual items were classified into groups according to the type of retail container through manual posting. The movement of these groups was then compared with the actual damage in order to obtain a general index of the most damage-prone items.

Labor costs were obtained from company records or by time study techniques when detailed analysis was required. In the latter case, the jobs were broken down into elements, and the time to perform the elements was measured with a stopwatch. The time for the various elements was then adjusted to reflect the speed of the average operator working at a normal pace and was applied to the frequency at which the element occurred to develop the production standard.

The salvaging operation was studied in one firm and improved through the application of industrial engineering principles of workplace arrangement, work methods, and product flow.

Data were collected in the five stores by a reporting procedure similar to that used in the warehouse studies. After inspecting each facility and consulting with the manager and store personnel, a list of over 50 causes of damage was compiled. Each cause was assigned an identifying number to facilitate recordkeeping. The causes were divided into five activity groups, so that a given cause could be easily located by the person recording the damage. These groups were: Receiving, price-marking, stocking, checkout, and other causes, mostly damage caused by customers.

Printed lists were posted at the collection point for damaged items in the storerooms of the five stores, along with a form to record the quantity damaged, item description, selling price, and the damage reason number. The reporting procedure was described to each store employee and his cooperation solicited. The stores were visited several times during the week to encourage store personnel to record the desired information. Once a week the forms were collected

and checked against the amount of damaged goods on hand to determine the level of employee performance. In most studies involving the participation of store employees, 100 percent performance is most difficult to achieve, because of human factors. The level of performance in the 5 stores ranged from 50 to 100 percent, with an average of 70 percent. Most of the stores did a good job of recording the damage, but some did not list reasons for all items. Data from stores A, C, and D, which did record every instance of damage, were used to determine the extent of damage in relation to retail sales.

APPENDIX

Tables 12 and 13 show the causes of damage in the individual warehouses and the extent of damage in relation to movement of 100,000 cases. Some reasons and reason numbers were deleted from the tables because no damage was attributed to them.

Concealed damage is presented within parentheses and is not included in column totals nor in the percentage distributions.

Table 14 shows the causes of damage in 5 supermarkets. Items within parentheses are not included in percentage distributions. Some reason numbers were omitted because no damage occurred for the reason. Numbered reasons such as 12A were added after the study was in progress and an overlooked cause was discovered.

Tables 15 through 20 show causes of damage to individual categories of grocery items. Such numbered reasons from these tables are included in general categories in table 14. Concealed damage and spoilage are included in category distributions in tables 15 through 20 but excluded in table 14.

Table 12.--Number of cases damaged in three grocery warehouses, per 100,000 cases shipped, by causes common to all three warehouses

Reason No.	Class of activity and reason	Damaged merchandise				Proportion of total damage			
		Warehouse A	Warehouse B	Warehouse C	Average	Warehouse A	Warehouse B	Warehouse C	Average 1/
		Cases	Cases	Cases	Cases	Pct.	Pct.	Pct.	Pct.
	Class I--Receiving, travel to storage, and slot replenishment								
1	Damaged during palletizing--due to poor shipping container	0.8	1.5	0.9	1.2	0.3	1.6	1.1	0.8
3	Fell off pallet from car to dock	2.3	.1	3.2	1.7	.8	.1	3.7	1.2
4	Fell off pallet when engaged by lift truck	1.7	.6	.7	.9	.6	.6	.9	.6
6	Fell off pallet because of slick surface of case	.4	1.8	.2	.9	.1	1.9	.2	.6
10	Fell while being maneuvered into storage	6.1	1.4	2.0	2.9	2.1	1.5	2.4	2.0
11	Bad swing into slot--putting into storage	.4	.6	1.3	.7	.1	.6	1.5	.5
13	Cases overhanging pallet edge--putting into storage	1.5	4.4	.2	2.3	.5	4.8	.2	1.6
15	Forklift backed into merchandise	7.4	.7	.2	2.4	2.6	.7	.2	1.7
17	Bad letdown-narrow slot	1.9	13.2	.2	6.1	.7	14.5	.2	4.3
	Class II--Order selection and travel to shipping dock								
30	Dropped in aisle	38.7	7.3	8.0	16.1	13.6	7.9	9.4	11.3
31	Damaged during removal from second rack slot	23.9	3.6	2.0	8.6	8.4	3.9	2.4	6.0
33	Nails in pallet	41.4	9.5	1.7	15.8	14.6	10.5	2.0	11.0
36	Stack fell over--weak shipping container	6.5	.4	.6	2.1	2.3	.4	.7	1.5
39	Damaged in rack--obviously done in filling rack	34.9	.7	9.9	12.8	12.2	.7	11.6	9.0
40	Damaged by forks on truck	26.6	5.0	16.6	14.4	9.3	5.3	19.4	10.1
41	Concealed damage 2/	(14.2)	(7.4)	(4.7)	(8.4)				
47	Set down too hard on selector truck	7.2	1.8	1.3	3.1	2.5	1.9	1.5	2.2
	Class III--Shipping dock and truck loading								
52	Fell off selector truck while truck was being removed from towline	.2	.4	.2	.3	.1	.4	.2	.2
53	Fell off selector truck while truck was being positioned on dock	1.1	.4	.4	.6	.4	.4	.4	.4
54	Fell off selector truck while truck was being pushed into trailer	1.5	4.4	4.5	3.6	.5	4.8	5.2	2.5
55	Stack fell over in trailer during loading	.6	1.5	1.9	1.4	.2	1.6	1.4	1.0
56	Dropped case in trailer	4.2	.8	1.7	2.0	1.5	.9	2.0	1.4
	Totals	209.3	60.1	57.7	99.9	73.4	65.0	66.6	69.9

1/ Percentage of the total damage from all three warehouses exclusive of concealed damage.
2/ Items within parentheses are not included in the distribution.

Table 13.--Number of cases damaged in three grocery warehouses, per 100,000 cases shipped, by unique causes

Reason No.	Class of activity and reason	Damaged merchandise			Percent of total damage from three warehouses
		Warehouse A	Warehouse B	Warehouse C	
	Class I.--Receiving, travel to storage, and slot replenishment	Cases	Cases	Cases	Percent
2	Broken containers--poor container	--	3.2	--	0.9
5	Fell off pallet because of jerky clutch in lift truck.	--	1.2	--	.4
7	Dropped by unloader in car or trailer	--	1.1	.4	.4
8	Fell off pallet while traveling in aisle from dock to storage	5.1	.1	--	1.0
9	Fell off pallet traveling from dock to storage when turning corner	2.5	--	--	.5
12	Narrow slot--putting into storage	.8	4.5	--	1.5
14	Hit rack--putting into storage	7.8	.4	--	1.6
16	Hit by pallet being lowered from rack above	3.6	7.8	--	3.0
18	Bad letdown--due to badly stacked merchandise	.6	4.7	--	1.5
19	Other reasons	.8	--	.7	.3
21	Crushed--heavy merchandise stacked too high	--	--	5.0	1.1
24	Leaning stack	--	--	4.8	1.0
25	Rammed into by hitch on lift truck	--	.6	--	.2
26	Rammed into by tractor or lift truck	--	2.2	--	.6
27	Fell off selector truck	.4	--	--	.1
28	Stacked too high--crushed	--	.3	--	.1
29	Crushed--unknown	--	.1	--	--
	Class II--Order selection and travel to shipping dock				
32	Broken when pallet was pulled from under merchandise	2.5	--	--	.5
34	Pallet on top--nails	--	.8	--	.2
35	Damaged by bars in back of rack	24.5	--	--	4.9
37	Stack fell over	--	.3	--	.1
38	Fell off rack	--	.4	--	.1
42	Rammed into on corner	4.6	.4	--	1.0
43	Fell off train rounding corner	--	.8	--	.2
44	Fell off while truck was being hooked on towline	5.5	--	.9	1.2
46	Rammed by handtruck on towline	5.1	--	--	1.0
48	Jammed against column	--	--	.7	.2
49	Fell off train after collision with handtruck on towline	.6	--	--	.1
50	Damaged by pallet wing	--	--	13.0	2.8
51	Fell off towline--bad wheels on selector truck	--	--	.2	--
	Class III--Shipping dock and truckloading				
57	Hit top of trailer--stacked too high on selector truck	--	--	1.9	.4

Table 13.--Number of cases damaged in three grocery warehouses, per 100,000 cases shipped, by unique causes--Continued

Reason No.	Class of activity and reason	Damaged merchandise			Percent of total damage from three warehouses
		Warehouse A	Warehouse B	Warehouse C	
		Cases	Cases	Cases	Percent
	Class IV--Other reasons				
58	Leaker	.4	.1	--	.1
59	Short	4.4	.7	--	1.0
60	Wet	1.3	--	--	.2
61	Rusty	.2	.8	--	.2
62	Corner tear by order filler (Bags)	--	1.5	--	.4
63	Swelled	.6	.1	--	.2
64	Sideswiped by equipment in aisle	--	.3	--	.1
65	Loose caps	.4	--	--	.1
66	Broken pallet	4.0	--	--	.8
67	No cap	.4	--	--	.1
	Totals	76.1	32.4	27.6	1/ 30.1

1/ The unique causes of damage represent 26.6 percent of the damage in warehouse A, 35.0 percent in warehouse B, and 33.4 percent in warehouse C (exclusive of concealed damage, which amounted to 5.6 percent of all damage).

Table 14.--Causes and amount of damage to merchandise in five supermarkets

Reason No.	Reason	Merchandise damaged						Proportion of total damage					
		Store A	Store B	Store C	Store D	Store E	Total	Store A	Store B	Store C	Store D	Store E	Total
		Units	Units	Units	Units	Units	Units	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
1	Fell off conveyor from trailer	21	2	1/ 1	72	55	151	6.1	1.3	0.3	17.9	23.2	10.4
2	Fell off conveyor going to basement	2/ 5	--	--	14	24	43	1.5	--	--	3.5	10.1	2.9
3	Fell off or crushed by jam-up on conveyor	12	1	--	28	13	54	3.5	.6	--	7.0	5.5	3.7
4	Fell off conveyor at turn	--	--	--	5	--	5	--	--	--	1.2	--	.4
5	Dropped while being put away during receiving	12	18	3	3	--	36	3.5	11.3	.9	.8	--	2.5
6	Units fell out of open or torn shipping container 3/	9	3	1	11	7	31	2.6	1.9	.3	2.8	2.9	3/ 2.1
7	Carton damaged by case cutter 3/	91	26	48	68	48	281	26.6	16.3	15.1	17.0	20.3	3/19.3
9	Case dropped while being taken from stock 3/	4	1	13	7	1	26	1.2	.6	4.1	1.8	.4	3/ 1.8
10	Merchandise crushed in stack 3/	4	2	19	16	3	44	1.2	1.3	5.9	4.0	1.3	3/ 3.0
11	Stack fell over in backroom 3/	1	5	16	23	15	60	.3	3.1	5.0	5.8	6.3	3/ 4.1
12	Concealed damage	(190)	(103)	(441)	(311)	(170)	(1215)	--	--	--	--	--	--
12A	Missing labels 3/	(78)	(26)	(219)	(56)	(23)	(402)	--	--	--	--	--	--
13	Units fell out of case while being taken from stock	--	3	3	1	--	7	--	1.9	.9	.2	--	.5
14	Units fell out of case during price marking	--	--	7	3	--	10	--	--	2.2	.8	--	.7
15	Fell off 4-wheeler taking it to sales area	--	1	--	3	4/ 2	6	--	.6	--	.8	.8	.4
16	Fell off 2-wheeler taking it to sales area	--	--	7	--	--	7	--	--	2.2	--	--	.5
17	Dropped during price changing	--	--	1	4	--	5	--	--	.3	1.0	--	.3
18	Unit dropped during stocking of shelf 3/	42	13	6	30	3	94	12.3	8.2	1.9	7.5	1.3	3/ 6.4
19	Unit dropped during rearranging of shelf	--	3	2	--	--	5	--	1.9	.6	--	--	.3
20	Damaged during filling of dump display	7	--	6	--	--	13	2.0	--	1.9	--	--	.9
21	Broken during building of end display	--	9	8	--	--	17	--	5.7	2.5	--	--	1.2
22	Broken while display was being taken down	23	3	10	--	1	37	6.7	1.9	3.1	--	.4	2.5
23	Damaged while display merchandise was being put into backroom	7	2	1	--	--	10	2.0	1.3	.3	--	--	.7
24	Damaged during consolidating of loose units in case	--	2	1	2	--	5	--	1.3	.3	.5	--	.3
25	Whole case dropped during shelving of units	--	1	9	4	--	14	--	.6	2.8	1.0	--	1.1
27	Unit fell off shelf--should have had divider	1	2	--	--	4	7	.3	1.3	--	--	1.7	.5
28	Fell off shelf because of stock man on other side of gondola	1	--	--	3	--	4	.3	--	--	.8	--	.3
29	Fell off shelf--knocked off by falling merchandise	6	--	--	3	1	10	1.8	--	--	.8	.4	.7
30	Fell off shelf--knocked off by falling end display	--	1	2	--	--	3	--	.6	.6	--	--	.2
31	End display rammed by handtruck	--	1	--	1	2	4	--	.6	--	.2	.8	.3
32	Dropped by customer 3/	15	23	43	49	19	149	4.4	14.5	13.5	12.2	8.0	3/10.2
33	Fell off shelf when disturbed by customer 3/	41	10	47	9	30	137	12.0	6.3	14.8	2.2	12.6	3/ 9.4
34	Fell off bottom of shopping cart	1	2	2	--	--	5	.3	1.3	.6	--	--	.3
35	Broken or crushed in shopping cart 3/	5	5	22	9	1	42	1.5	3.1	7.0	2.2	.4	3/ 2.9

Table 14.--Causes and amount of damage to merchandise in five supermarkets--Continued

Reason No.	Reason	Merchandise damaged						Proportion of total damage					
		Store A	Store B	Store C	Store D	Store E	Total	Store A	Store B	Store C	Store D	Store E	Total
		Units	Units	Units	Units	Units	Units	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
36	Broken by children throwing it from cart	--	3	3	--	2	8	--	1.9	.9	--	.8	.5
37	Broken by children--fell off shelf	7	--	4	--	2	13	2.0	--	1.2	--	.8	.9
38	Dropped by customer unloading shopping cart 3/	12	15	9	3	2	41	3.5	9.4	2.8	.8	.8	3/ 2.8
39	Dropped by bagboy unloading shopping cart	--	--	1	--	--	1	--	--	.3	--	--	.1
40	Fell off counter while merchandise was being pulled toward checker	--	--	4	--	1	5	--	--	1.2	--	.4	.3
41	Fell off counter--merchandise backed up on counter	--	--	--	--	1	1	--	--	--	--	.4	.1
42	Fell off counter when checker reached for it	--	--	3	--	--	3	--	--	.9	--	--	.2
43	Crushed or torn when piled on checking counter	4	1	6	1	--	12	1.2	.6	1.9	.2	--	.8
45	Dropped during bagging	--	--	8	--	--	8	--	--	2.5	--	--	.5
46	Broken when bag burst	7	--	3	9	1	20	2.0	--	.9	2.2	.4	1.4
47	Broken during carry-out	2	1	1	8	--	12	.6	.6	.3	2.0	--	.8
48	Other and unknown	(111)	(69)	(79)	(95)	(37)	(391)	--	--	--	--	--	--
49	Spoiled	(397)	(53)	(85)	(71)	(53)	(659)	--	--	--	--	--	--
50	Spoiled by heat	2	--	--	11	--	13	.6	--	--	2.8	--	.9
51	Out of date	(170)	--	--	--	--	--	--	--	--	--	--	--
	Total damage	342	159	320	400	238	1459	100.0	100.0	100.0	100.0	100.0	100.0

1/ Fell off pallet, not conveyor.
2/ In storeroom during receiving.
3/ Common to all five stores. The total number of units damaged by these common causes in all five stores was 905. The percentage of total damage from common causes in all stores was 62 percent; the other 38 percent was due to unique causes.
4/ Fell off conveyor traveling from basement to sales floor.

Table 15.--Causes and amount of damage to grocery items packaged in paperboard containers in five supermarkets

Reason No.	Reason	Units damaged	Percent of group damage	Cumulative
		No.	Percent	Percent
7	Carton damaged by cutter blade when cutting case	251	34.90	34.90
12	Concealed damage	91	12.66	47.56
1	Fell off conveyor or pallet from trailer	39	5.42	52.98
48A	Miscellaneous and unknown	30	4.17	57.15
55	Miscellaneous customer damage	32	4.45	61.60
3	Fell off or crushed by jam-up on conveyor	26	3.62	65.22
11	Stack fell over in backroom	23	3.20	68.42
33	Fell off shelf when disturbed by customer	23	3.20	71.62
10	Merchandise crushed in stack	21	2.92	74.54
21	Damaged during building of end display	21	2.92	77.46
49A	Spoiled by water	21	2.92	80.38
49	Spoiled	20	2.78	83.16
32	Dropped by customer	13	1.81	84.97
35	Broken or crushed in shopping cart	13	1.81	86.78
18	Unit dropped during stocking	12	1.67	88.45
5	Dropped while being put away during receiving	10	1.39	89.84
2	Fell off conveyor going to basement	7	.97	90.81
9	Case dropped while being taken from stock	7	.97	91.78
29	Fell off shelf--knocked off by falling merchandise	7	.97	92.75
6	Units fell out of open or torn shipping container	6	.83	93.58
12A	Missing label	6	.83	94.41
54	Glue from shipping container damaged contents	6	.83	95.24
37	Broken by children-- fell off shelf	5	.70	95.94
43	Crushed or torn when piled on checking counter	5	.70	96.64
24	Damaged during consolidating of loose units in case	3	.42	97.06
50	Spoiled by heat	3	.42	97.48
17	Dropped during price changing	2	.28	97.76
20	Damaged during filling of dump display	2	.28	98.04
36	Damaged by children throwing it from cart	2	.28	98.32
38	Dropped by customer unloading shopping cart	2	.28	98.60
48B	Pilfered	2	.28	98.88
4	Fell off conveyor at turn	1	.14	99.02
14	Units fell out of case during price marking	1	.14	99.16
21	Damaged during building of end display	1	.14	99.30
25	Whole case dropped during shelving of units	1	.14	99.44
31	End display rammed by handtruck	1	.14	99.58
34	Fell off bottom of shopping cart	1	.14	99.72
46	Broken when bag burst	1	.14	99.86
47	Broken during carry-out	1	.14	100.00
	Total	719	100.00	

Table 16.--Causes and amount of damage to grocery items packaged in glass jars in five supermarkets

Reason No.	Reason	Units damaged	Percent group damage	Cumulative
		No.	Percent	Percent
12	Concealed damage	62	21.55	21.55
49	Spoiled	44	15.28	36.83
33	Fell off shelf when disturbed by customer	28	9.72	46.55
32	Dropped by customer	25	8.68	55.23
1	Fell off conveyor or pallet from trailer	19	6.60	61.83
2	Fell off conveyor going to basement	16	5.56	67.39
48A	Miscellaneous other causes and unknown	13	4.51	71.90
18	Unit dropped while being placed on shelf	11	3.82	75.72
11	Stack fell over in backroom	10	3.47	79.19
12A	Missing label	8	2.78	81.97
25	Whole case dropped during shelving of units	6	2.08	84.05
9	Case dropped while being taken from stock	4	1.39	85.44
38	Dropped by customer unloading shopping cart	4	1.39	86.83
20	Broken during filling of dump display	3	1.04	87.87
37	Broken by children--fell off shelf	3	1.04	88.91
40	Fell off counter when merchandise was being pulled toward checker	3	1.04	89.95
42	Fell off counter--reached for by checker	3	1.04	90.99
5	Dropped while being put away during receiving	2	.69	91.68
6	Units fell out of open or torn shipping container	2	.69	92.37
13	Units fell out while being taken from stock	2	.69	93.06
14	Units fell out of case during price marking	2	.69	93.75
15	Fell off handtruck while being taken to sales area	2	.69	94.44
23	Broken while display merchandise was being put into backroom	2	.69	95.13
27	Unit fell off shelf--should have had divider	2	.69	95.82
35	Broken or crushed in shopping cart	2	.69	96.51
46	Broken when bag burst	2	.69	97.20
3	Fell off or crushed by jam-up on conveyor	1	.35	97.55
19	Unit dropped during rearranging of shelf	1	.35	97.90
21	Damaged during building of end display	1	.35	98.25
30	Fell off shelf--knocked off by falling end display	1	.35	98.60
34	Fell off bottom of shopping cart	1	.35	98.95
36	Broken by children throwing it from cart	1	.35	99.30
45	Dropped while bagging	1	.35	99.65
47	Broken during carry-out	1	.35	100.00
	Total	288	100.00	

Table 17.--Causes and amount of damage to grocery items packaged in paper bags in five supermarkets

Reason No.	Reason	Units damaged	Percent of group damage	Cumulative
		No.	Percent	Percent
12	Concealed damage	111	37.23	
48A	Miscellaneous and unknown	32	10.74	47.97
1	Fell off conveyor or pallet from trailer	23	7.72	55.69
18	Unit dropped during stocking of shelf	22	7.38	63.07
3	Fell off or crushed by jam-up on conveyor	10	3.36	66.43
35	Broken or crushed in shopping cart	10	3.36	69.79
6	Units fell out of open or torn shipping container	8	2.68	72.47
47	Broken during carry-out	8	2.68	75.15
7	Damaged by case cutter	8	2.68	77.83
2	Fell off conveyor going to basement	6	2.01	79.84
38	Dropped by customer unloading shopping cart	6	2.01	81.85
46	Broken when shopping bag burst	6	2.01	83.86
5	Dropped while being put away during receiving	5	1.68	85.54
32	Dropped by customer	5	1.68	87.22
33	Fell off shelf when disturbed by customer	5	1.68	88.90
49	Spoiled	5	1.68	90.58
55	Miscellaneous customer damage	4	1.34	91.92
16	Fell off two-wheel handtruck taking it to sales area	3	1.01	92.93
43	Crushed or torn when piled on checkout counter	3	1.01	93.94
56	Damaged by pallet	3	1.01	94.95
10	Merchandise crushed in stack	2	.67	95.62
13	Units fell out of case while being taken from stock	2	.67	96.29
14	Units fell out of case during price marking	2	.67	96.96
22	Damaged while display was being taken down	2	.67	97.63
45	Dropped during bagging	2	.67	98.30
4	Fell off conveyor at turn	1	.34	98.64
23	Damaged while display merchandise was being put in the backroom	1	.34	98.98
25	Whole case dropped during shelving of units	1	.34	99.32
34	Fell off bottom of shopping cart	1	.34	99.66
39	Dropped by bagboy unloading shopping cart	1	.34	100.00
	Total	298	100.00	

Table 18.--Causes and amount of damage to bottled grocery items in five supermarkets

Reason No.	Reason	Units damaged	Percent of group damage	Cumulative
		No.	Percent	Percent
12	Concealed damage	51	17.43	
33	Fell off shelf when disturbed by customer	39	13.31	30.74
1	Fell off conveyor or pallet from trailer	34	11.60	42.34
48A	Miscellaneous other reasons and unknown	38	9.56	51.90
32	Dropped by customer	25	8.53	60.43
11	Stack fell over in backroom	24	8.19	68.62
18	Unit dropped during stocking	20	6.83	75.45
38	Dropped by customer unloading shopping cart	10	3.41	78.86
49	Spoiled	9	3.07	81.93
12A	No label	9	3.07	85.00
2	Fell off conveyor going to basement	6	2.05	87.05
23	Damaged while display merchandise was being put into backroom	5	1.71	88.76
3	Fell or crushed by jam-up on conveyor	5	1.71	90.47
9	Case dropped while being taken from stock	4	1.37	91.84
5	Case dropped while being put away during receiving	3	1.02	92.86
13	Units fell out of case while being taken from stock	3	1.02	93.88
35	Broken or crushed in shopping cart	3	1.02	94.90
37	Broken by children--fell off shelf	2	.68	95.58
29	Fell off shelf--knocked off by falling merchandise	2	.68	96.26
31	End display rammed by handtruck	2	.68	96.94
15	Fell off handtruck taking it to sales area	2	.68	97.62
47	Broken during carry-out	1	.34	97.96
19	Unit dropped during rearranging of shelf	1	.34	98.30
13	Units fell out of case while being taken from stock	1	.34	98.64
45	Dropped during bagging	1	.34	98.98
40	Fell off counter while merchandise was being pulled toward checker	1	.34	99.32
41	Fell off counter - merchandise backed up on counter	1	.34	99.66
6	Units fell out of open or torn shipping container	1	.34	100.00
	Total	293	100.00	

Table 19.--Causes and amount of damage to canned grocery items in five supermarkets

Reason No.	Reason	Units damaged	Percent of group damage	Cumulative
		No.	Percent	Percent
12	Concealed	829	41.22	
49	Spoiled	523	26.03	67.25
12A	Missing labels	355	17.67	84.92
1	Fell off conveyor from trailer	44	2.19	87.11
48A	Misc. other reasons and unknown	44	2.19	89.30
51	Out of date	26	1.29	90.59
2	Fell off conveyor going to basement	20	1.00	91.59
32	Dropped by customer	19	.95	92.54
6	Units fell out of torn shipping container	13	.66	93.20
18	Unit dropped during stocking of shelf	12	.60	93.80
-	Leaker	11	.55	94.35
3	Fell off or crushed by jam-up on conveyor	11	.55	94.90
22	Damaged while display was being taken down	11	.55	95.45
33	Fell off shelf when disturbed by customer	11	.55	96.00
54	Glue from shipping container damaged contents	9	.45	96.45
9	Case dropped while being taken from stock	8	.40	96.85
10	Merchandise crushed in stack	7	.35	97.20
25	Whole case dropped during shelving of units	6	.30	97.50
11	Stack fell over in backroom	5	.25	97.75
14	Units fell out of case during price marking	5	.25	98.00
17	Dropped during price changing	4	.20	98.20
16	Fell off two-wheel handtruck	4	.20	98.40
46	Damaged when bag burst	3	.15	98.55
35	Damaged in shopping cart	3	.15	98.70
4	Fell off conveyor at turn	3	.15	98.85
5	Dropped while being put away during receiving	3	.15	99.00
30	Fell off shelf--knocked off by falling end display	3	.15	99.15
45	Dropped during bagging	2	.10	99.25
37	Damaged by children--fell off shelf	2	.10	99.35
38	Dropped by customer unloading shopping cart	2	.10	99.45
50	Spoiled by heat	2	.10	99.55
21	Damaged during building of end display	2	.10	99.65
15	Fell off four-wheeler taking it to sales area	1	.05	99.70
29	Fell off shelf - knocked off by falling merchandise	1	.05	99.75
24	Dropped during consolidating of loose units in case	1	.05	99.80
36	Damaged by children throwing it from cart	1	.05	99.85
40	Fell off counter while merchandise was being pulled toward checker	1	.05	99.90
43	Crushed or torn when piled high on checking counter	1	.05	99.95
27	Fell off shelf--should have had divider	1	.05	100.00
	Total	2,009	100.00	

Table 20.--Causes and amount of damage to grocery items packaged in plastic bags in five supermarkets

Reason number	Reason	Units damaged	Percent of group damage	Cumulative
		No.	Percent	Percent
12	Concealed damage	25	20.64	---
49	Spoiled	21	17.36	38.00
7	Damaged by case cutting	20	16.53	54.53
48A	Misc. other causes and unknown	11	9.09	63.62
10	Mdse. crushed in stack	10	8.26	71.88
38	Dropped by customer unloading shopping cart	9	7.44	79.32
33	Fell off shelf when disturbed by customer	5	4.13	83.45
35	Broken or crushed in shopping cart	4	3.31	86.76
22	Damaged while display was being taken down	3	2.48	89.24
2	Fell off conveyor going to basement	2	1.65	90.89
43	Crushed or torn when piled on checkout counter	2	1.65	92.54
55	Misc. customer damage	2	1.65	94.19
6	Units fell out of open or torn shipping container	1	.83	95.02
12A	Missing labels	1	.83	95.85
18	Unit dropped during stocking of shelf	1	.83	96.68
32	Dropped by customer	1	.83	97.51
34	Fell off bottom of shopping cart	1	.83	98.34
45	Dropped during bagging	1	.83	99.17
46	Broken when shopping bag burst	1	.83	100.00
	Total	121	100.00	

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